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CBSE Examination Paper 2026

Class XII

Biology (044)

Time : 3 Hours **Max. Marks : 70**

General Instructions:

Read the following instructions carefully and follow them:

1. This question paper contains 33 questions. All questions are compulsory.
2. Question paper is divided into five sections - Sections A, B, C, D and E.
3. Section A - questions number 1 to 16 are Multiple Choice Type questions. Each question carries 1 mark.
4. Section B - questions number 17 to 21 are Very Short Answer Type questions. Each question carries 2 marks.
5. Section C - questions number 22 to 28 are Short Answer Type questions. Each question carries 3 marks.
6. Section D - questions number 29 and 30 are Case-Based questions. Each question carries 4 marks. Each question has subparts with internal choice in one of the subparts.
7. Section E - questions number 31 to 33 are Long Answer Type questions. Each question carries 5 marks.
8. There is no overall choice. However, an internal choice has been provided in Sections B, D and E of the question paper. A candidate has to write answer for only one of the alternatives in such questions.
9. Kindly note that there is a separate question paper for Visually Impaired Candidates.
10. Wherever necessary, neat and properly labelled diagrams should be drawn..

SECTION-A

Questions no. 1 to 16 are Multiple Choice Type Questions, carrying 1 mark each. Choose the best option.

1. The foetal ejection reflex in humans triggers the release of _____ hormone from _____.
Fill in the blanks by choosing right option.
(A) oxytocin, foetal pituitary
(B) oxytocin, maternal pituitary
(C) human chorionic gonadotropin, placenta
(D) progesterone, corpus luteum

Ans :

(B) oxytocin, maternal pituitary
The foetal ejection reflex is initiated by signals from the fully developed foetus and placenta, causing mild uterine contractions. These signals stimulate the maternal posterior pituitary gland to release oxytocin. Oxytocin intensifies uterine contractions during childbirth, forming a positive feedback mechanism essential for parturition.

2. Match the IUDs in Column I with suitable example in Column II.

	Column I		**Column II**
a.	Non-medicated	i.	Lippes loop
b.	Copper releasing	ii.	LNG-20
c.	Hormone releasing	iii.	Multiload 375

(A) a-iii, b-ii, c-i
(B) a-i, b-ii, c-iii
(C) a-i, b-iii, c-ii
(D) a-ii, b-i, c-iii

Ans :

(C) a-i, b-iii, c-ii
Non-medicated IUDs include Lippes loop. Copper-releasing IUDs include Multiload 375, which releases copper ions that reduce sperm motility. Hormone-releasing IUDs like LNG-20 release progesterone, thickening cervical mucus and inhibiting implantation. Thus, correct matching is a-i, b-iii, c-ii.

3. In Pisum sativum, the flower colour may be violet (V) or white (v). What proportion of the offspring in a cross of "VV × vv" would be expected to be violet?
(A) 25%
(B) 50%
(C) 75%
(D) 100%

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Ans :

(D) 100%
In the cross VV × vv, the gametes produced are V and v respectively. All offspring receive one dominant allele (V) and one recessive allele (v), resulting in genotype Vv. Since violet colour is dominant over white, all offspring express violet phenotype. Hence, 100% of offspring are violet.

4. Arrange the following in the correct sequence of their evolution and select the correct option:
(i) Seaweed
(ii) Invertebrates
(iii) Jawless fish
Options :
(A) (i), (ii), (iii)
(B) (i), (iii), (ii)
(C) (ii), (iii), (i)
(D) (ii), (i), (iii)

Ans :

(A) (i), (ii), (iii)
Seaweeds (algae) are among the earliest photosynthetic organisms. Invertebrates evolved later as simple multicellular animals without a backbone. Jawless fishes (like Agnatha) are primitive vertebrates that appeared after invertebrates. Thus, the evolutionary sequence progresses from seaweed → invertebrates → jawless fish.

5. If a genetic disease is transferred from a phenotypically normal but carrier female to only some of the male progeny, the disease is:
(A) autosomal dominant
(B) autosomal recessive
(C) sex-linked dominant
(D) sex-linked recessive

Ans :

(D) sex-linked recessive
In sex-linked recessive inheritance, carrier females (heterozygous) are phenotypically normal but can pass the defective gene to sons. Males, having only one X chromosome, express the disease if they inherit the affected allele. This pattern commonly appears in disorders like haemophilia and colour blindness.

6. A DNA molecule is 160 base pairs long. It has 30% Guanine. How many Adenine bases are present in this DNA molecule?
(A) 48
(B) 64
(C) 96
(D) 192

Ans :

(B) 64
In DNA, %G = %C and %A = %T.
If Guanine is 30%, Cytosine is also 30%, totaling 60%. Remaining 40% consists of Adenine and Thymine equally,
So Adenine = 20%.
Total bases = 160 × 2 = 320 nucleotides.
Adenine = 20% of 320 = 64 bases.

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7. A doctor identifies symptoms of nasal congestion, headache, sore throat, hoarseness, and cough in a patient. The conclusion is that the patient is infected by a pathogen:
(A) Plasmodium
(B) Adenovirus
(C) Salmonella
(D) Rhinovirus

Ans :

(D) Rhinovirus
Rhinoviruses are the most common cause of the common cold, producing symptoms such as nasal congestion, sore throat, cough, and headache. Adenoviruses may cause respiratory infections but are less specific for common cold. Plasmodium causes malaria, and Salmonella causes food poisoning, not respiratory illness.

8. Which type of selection is industrial melanism observed in moth, Biston betularia?
(A) Stabilising
(B) Directional
(C) Disruptive
(D) Artificial

Ans :

(B) Directional
Industrial melanism in Biston betularia is a classic example of directional selection. Due to industrial pollution, darker moths gained a survival advantage over lighter ones. Natural selection favored one extreme phenotype (melanic form), shifting the population in a specific direction, hence classified as directional selection.

9. C-peptide of human insulin is:
(A) a part of mature insulin molecule
(B) responsible for formation of disulphide bridges

(C) removed during maturation of pro-insulin to insulin
(D) responsible for its biological activity

Ans :

(C) removed during maturation of pro-insulin to insulin
Insulin is initially synthesized as proinsulin, which contains A, B, and C-peptide chains. During maturation, the C-peptide is removed, leaving the active insulin composed of A and B chains linked by disulphide bonds. Thus, C-peptide is not part of mature insulin and has no direct biological activity.

10. Given below is the restriction site of a restriction endonuclease Pst I and the cleavage sites on a DNA molecule.

5′ C – T – G – C – A ↓ G 3′
3′ G ↑ A – C – G – T – C 5′

Choose the option that gives the correct resultant fragments.

(A) 5′ C – T – G C – A – G 3′
3′ G – A – C – G – T – C 5′
(B) 5′ C – T G – C – A – G 3′
3′ G – A – C – G T – C 5′
(C) 5′ C – T – G – C A – G 3′
3′ G – A – C – G T – C 5′
(D) 5′ C – T – G – C – A G 3′
3′ G A – C – G – T – C 5′

Ans :

(A) 5′ C – T – G C – A – G 3′
3′ G – A – C – G – T –C 5′

Pst I recognizes the sequence 5'–CTGCAG–3' and cuts between A and G, producing sticky ends. The cleavage generates overhanging ends: one fragment ends with CTGCA, and the other begins with G. Option (A) correctly represents the staggered cut and resulting complementary sticky ends formed after digestion.

11. Which of the following fish led to the extinction of an ecologically unique assemblage of more than 200 species of cichlid fish in Lake Victoria of East Africa?
(A) Catla catla
(B) Dogfish
(C) Nile Perch
(D) African Catfish

Ans :

(C) Nile Perch

The introduction of Nile perch into Lake Victoria caused severe ecological disruption. Being a voracious predator, it fed on native cichlid fishes, leading to the extinction of over 200 endemic species. This is a classic example of how invasive species can drastically alter biodiversity and ecosystem balance.

12. Cattle or goats are never seen browsing on the weed, Calotropis. Select the correct option for the reason.
(A) The plant produces highly poisonous tannins.
(B) The plant produces quinine, which is bitter in taste.
(C) The plant produces poisonous chemical, cardiac glycoside.
(D) The plant bears prickles.

Ans :

(C) The plant produces poisonous chemical, cardiac glycoside.
Calotropis produces toxic cardiac glycosides, which are harmful to herbivores. These chemicals interfere with heart function and act as a defense mechanism against grazing animals. Due to this toxicity, cattle and goats avoid feeding on the plant, ensuring its survival in natural habitats.

For Questions number 13 to 16, two statements are given - one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below.

13. **Assertion (A) :** Repetitive sequences make up a very large portion of the human genome.
Reason (R) : Repetitive sequences do not have direct coding functions in the genome.
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Assertion (A) is false, but Reason (R) is true.

Ans :

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
Repetitive DNA sequences indeed constitute a major portion of the human genome. They generally do not code for proteins, supporting the

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reason statement. However, their abundance is not explained solely by their non-coding nature; evolutionary processes like duplication and transposition account for their large presence. Thus, both are true but not causally related.

14. **Assertion (A) :** The embryo with 8 to 16 blastomeres is called a morula.
Reason (R) : The morula continues to divide and transform into trophoblast.
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Assertion (A) is false, but Reason (R) is true.

Ans :

(C) Assertion (A) is true, but Reason (R) is false.
The assertion is correct: an embryo with 8–16 blastomeres is called a morula. However, the reason is incorrect because the morula develops into a blastocyst, not directly into trophoblast. The trophoblast forms later as part of the blastocyst structure, not directly from morula.

15. **Assertion (A) :** The use of chitinase enzyme is necessary for the separation of DNA from yeast cells but not in the case of Spirogyra.
Reason (R) : Fungal cell wall is made up of fungal chitin.
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Assertion (A) is false, but Reason (R) is true.

Ans :

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
Yeast is a fungus, and its cell wall contains chitin. Chitinase is required to break this chitin layer for DNA extraction. Spirogyra, being an alga, has a cellulose cell wall and does not require chitinase. Therefore, both the assertion and reason are correct, and the reason explains the assertion.

16. **Assertion (A) :** Besides curdling of milk, LAB also improves its nutritional quality by increasing Vitamin B12.
Reason (R) : LAB, when present in the stomach, checks disease-causing microbes.
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Assertion (A) is false, but Reason (R) is true.

Ans :

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A)
Lactic Acid Bacteria (LAB) improve milk's nutritional value by increasing Vitamin B12 content, making the assertion true. LAB also inhibit harmful microbes in the gut, so the reason is true. However, this antimicrobial action does not explain the increase in Vitamin B12, so they are not causally related.

SECTION - B

17. State the role of thymus as a lymphoid organ. Name the cells that are released from it and mention their functions.

Ans :

The thymus is a primary lymphoid organ responsible for the maturation and differentiation of T-lymphocytes (T-cells). It provides an environment for developing immune competence and self-tolerance.
The cells released are T-lymphocytes, which perform functions such as:
Cell-mediated immunity
Destroying infected or cancerous cells
Regulating immune responses (helper and regulatory T-cells)

18. (a) Explain the mutually rewarding relationship between Yucca plant and species of moth.
or
(b) Pollination success will be reduced unless the orchid flower co-evolves with the pollinator. Explain.

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Ans :

(a) The Yucca plant and Yucca moth exhibit obligate mutualism. The female moth actively pollinates the flower by transferring pollen to the stigma. In return, it lays eggs in the ovary. The larvae feed on some developing seeds, while the plant still produces enough seeds for reproduction.

or

(b) Orchid flowers often have specialized structures adapted to specific pollinators. Co-evolution ensures that flower shape, nectar location, and pollinator body structure match perfectly. Without such adaptation, pollinators may not effectively transfer pollen, leading to reduced pollination efficiency and reproductive success.

19. (a) Differentiate between grazing food chain and detritus food chain.

or

(b) Ecological pyramids are widely accepted but they still have some limitations. Write any two limitations.

Ans :

(a)

Grazing Food Chain (GFC)	**Detritus Food Chain (DFC)**
Starts with living green plants (producers)	Starts with dead organic matter (detritus)
Energy flows from producers → herbivores → carnivores	Energy flows from detritus → decomposers → consumers
Directly dependent on solar energy	Indirectly dependent on solar energy
Major pathway ..in aquatic ecosystems	Major pathway in terrestrial ecosystems
Example: Grass → Deer → Tiger	Example: Dead leaves → Fungi → Earthworm

or

(b)

1. They do not consider organisms belonging to multiple trophic levels (e.g., omnivores).
2. They assume a simple food chain and do not account for complex food webs.

20. How do 'implants' act as an effective method of contraception in human females? Mention one advantage of implants over contraceptive pills.

Ans :

Implants release hormones (progestogens) that inhibit ovulation, thicken cervical mucus, and prevent implantation. This makes fertilization unlikely.

Advantage :

They provide long-term contraception without the need for daily intake, unlike oral pills.

21. (a) Explain any two methods of vectorless gene transfer.

or

(b) Name the most commonly used bioreactor. List the advantages of the bioreactor. Also write the importance of sampling ports.

Ans :

(a) 1. Microinjection : Foreign DNA is directly injected into the nucleus of a host cell using a micropipette.

2. Biolistics (Gene gun) : DNA-coated metal particles are shot into cells to introduce foreign DNA, mainly used in plants.

or

(b) DNA replication occurs in a fork because helicase unwinds the double helix, exposing two template strands. DNA polymerase synthesizes new strands only in 5'→3' direction, leading to continuous synthesis on one strand and discontinuous synthesis on the other.

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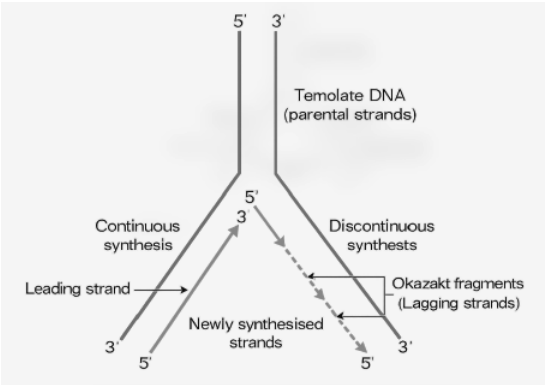
SECTION-C

22. Draw a labelled diagram of a 'replicating fork' showing the polarity. Why does DNA replication occur within such 'fork'?

Ans :



DNA replication occurs at the fork because helicase unwinds the DNA, exposing template strands. DNA polymerase synthesizes new DNA only in the $5' \rightarrow 3'$ direction, resulting in continuous synthesis on one strand and discontinuous synthesis on the other.

23. List any three outbreeding devices that flowering plants have developed for cross-pollination and explain how they help to encourage cross-pollination.

Ans :

Three outbreeding devices that flowering plants have developed for cross-pollination are as follows:

1. **Dichogamy :** Anther and stigma mature at different times, preventing self-pollination.
2. **Herkogamy :** Spatial separation of anther and stigma reduces chances of self-pollination.
3. **Self-incompatibility :** Genetic mechanism prevents pollen from fertilizing the same flower.

These mechanisms promote cross-pollination, increasing genetic diversity.

24. Explain how the following microbes act as biocontrol agents :

(a) Bacillus thuringiensis

(b) Nucleopolyhedrovirus

Ans :

(a) **Bacillus thuringiensis (Bt) :** Produces toxic protein crystals (Bt toxin) that kill insect larvae when ingested. The toxin disrupts the gut lining, causing death. It is widely used as a bio-pesticide and in genetically modified crops like Bt cotton.

(b) **Nucleopolyhedrovirus (NPV) :** These are viruses that infect and kill specific insect pests. They are highly host-specific and do not harm beneficial insects, plants, or humans, making them environmentally safe biocontrol agents.

25. Transgenic animals are produced by man. Explain any three ways in which such animals can be beneficial to humans.

Ans :

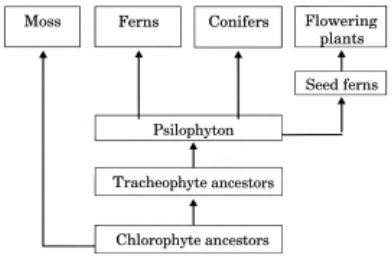
1. Production of therapeutic proteins : Transgenic animals produce human proteins (e.g., insulin, antibodies) in milk.
2. Disease study : Used as models to study human diseases like cancer.
3. Vaccine safety testing : Help in testing safety and efficacy of vaccines before human use.

26. Explain the level of biodiversity at genetic, species and ecological levels with the help of one example each.

Ans :

1. Genetic Diversity: It refers to variation in genes within a species. It enables a population to adapt to changing environments. Example: Different varieties of rice such as basmati and IR-36.
2. Species Diversity: It refers to the variety of species present in a particular area. Greater species diversity indicates a stable ecosystem. Example: A forest ecosystem with different species of plants, animals, and microbes.
3. Ecological Diversity: It refers to the variety of ecosystems in a geographical region. Example: India has diverse ecosystems like deserts, forests, grasslands, and wetlands.

27. Study the given chart showing the evolution of plants. Answer the following questions:



(a) Identify the plant which acts as an immediate ancestor of both ferns and conifers.

(b) Name the nearest ancestors of flowering plants.

(c) Name the most primitive group of plants.

(d) Psilophyton provides common ancestry to which classes?

(e) Name the common ancestor of psilophyton and seed ferns.

(f) Name the common ancestor of mosses and tracheophytes.

Ans :

(a) Psilophyton

(b) Seed ferns

(c) Chlorophyte ancestors (algae)

(d) Ferns and Conifers

(e) Tracheophyte ancestors

(f) Chlorophyte ancestors

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28. Given below is an equation describing the growth pattern of a population:

$$dN/dt = rN$$

(a) Mention the type of growth model or growth pattern of the population described by the given equation.
(b) What does 'r' in the equation signify?
(c) Mention the type of growth curve obtained if population density (N) is plotted against time (t).
(d) According to you, will the resource availability be limited or unlimited for this type of growth in the given population?

Ans :

(a) This equation represents the exponential growth model.
(b) 'r' represents the intrinsic rate of natural increase, i.e., the difference between birth rate and death rate in a population under ideal conditions.
(c) The growth curve obtained is a J-shaped curve.
(d) This type of growth assumes unlimited resources, allowing the population to grow rapidly without environmental resistance.

SECTION - D

Questions No. 29 and 30 are Case-Based questions. Each question has 3 sub-questions with internal choice in one sub-question.

29. Read the following passage and answer the questions that follow:
The process of copying genetic information from the template strand of DNA into RNA is called transcription. It is mediated by RNA polymerase. Transcription takes place in the nucleus of eukaryotic cells. In transcription, only a segment of DNA and only one of the
strands is copied into RNA.
(a) Why is the strand of DNA with 3′ → 5′ polarity transcribed and not the other strand of 5′ → 3′ polarity?
(b) (i) Why is hnRNA required to undergo splicing?

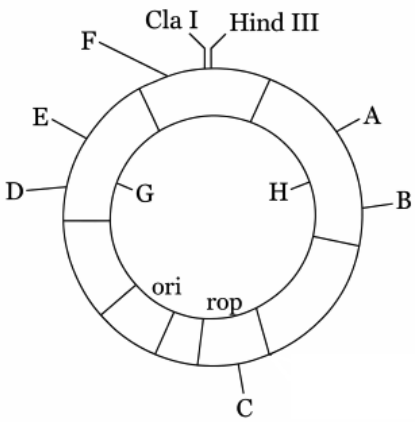
or

(ii) Mention the two additional processes which hnRNA needs to undergo after splicing to become functional.
(c) Why is only one strand of the DNA transcribed? Give two reasons.

Ans :

(a) RNA polymerase synthesizes RNA only in the 5' → 3' direction. Therefore, it must read the DNA template in the 3' → 5' direction. This ensures proper complementary base pairing and continuous RNA synthesis. Hence, the 3' → 5' strand acts as the template strand.
(b) (i) hnRNA contains both exons (coding regions) and introns (non-coding regions). Splicing removes introns and joins exons together to form functional mRNA. Without splicing, the RNA would contain non-functional sequences and cannot be properly translated into proteins.
(ii) 1. Capping : Addition of a methyl guanosine cap at the 5' end.
2. Tailing : Addition of a poly-A tail at the 3' end.
(c) (i) If both strands were transcribed, two complementary RNAs would form double-stranded RNA, which cannot be translated.
(ii) Transcribing both strands would lead to conflicting genetic information, as each strand codes for different proteins, causing cellular confusion.

30. Read the following passage and answer the questions that follow:
We know that plasmids and bacteriophages are the most commonly used vectors inbiotechnology experiments. If we can link an alien piece of DNA to the plasmid DNA, thealien DNA can be multiplied equal to the copy number of the plasmid. Engineered vectors are used these days. Study the diagram of the E. coli cloning vector pBR322 and answer the questions that follow:



(a) Why are plasmids and bacteriophages used as cloning vectors?

(b) (i) Identify :

(I) The gene in the cloning vector that controls the copy number of the vector.

(II) The restriction site - C in the 'rop' gene.

or

(ii) Identify and and name two selectable markers shown in the diagram.

(c) Name the two restriction sites each in the two genes you have identified as selectable markers.

Ans :

(a) Plasmids and bacteriophages can replicate independently inside host cells and have an origin of replication. They allow insertion of foreign DNA and produce multiple copies, making them suitable as cloning vectors.

(b) (i) (I) rop gene
(II) Pst I

or

(ii) (I) ampR (Ampicillin resistance gene)
(II) tetR (Tetracycline resistance gene)

(c) (i) ampR gene: Pst I, Pvu I
(ii) tetR gene: Bam HI, Hind III

SECTION-E

31. (a) Work out separate monohybrid crosses up to F_2 generation between two pea plants and two Antirrhinum plants, both having contrasting traits with respect to the colour of the flower. Comment on the patterns of inheritance in the crosses carried out in such two cases.

or

(b) Answer the following questions

(i) How does a chromosomal disorder differ from a Mendelian disorder? Write one example for each.

(ii) Name the phenomenon that leads to situations like 'XO' abnormality in humans. Also name this genetic disorder. How are individuals with an XO chromosomal abnormality affected? Write its symptoms as well as karyotype.

Ans :

(a) (i) Monohybrid Cross in Pea Plant (Complete Dominance)
Parental Cross (P):
VV (Violet) × vv (White)
Gametes : V and v
F_1 Generation:
All Vv (Violet)
F_1 Selfing:
Vv × Vv
F_2 Generation (Genotypic ratio):
VV : Vv : vv = 1 : 2 : 1
Phenotypic ratio:
Violet : White = 3 : 1

(ii) Monohybrid Cross in Antirrhinum (Incomplete Dominance)
Parental Cross (P):
RR (Red) × rr (White)
Gametes: R and r
F_1 Generation:
All Rr (Pink)
F_1 Selfing:
Rr × Rr
F_2 Generation (Genotypic ratio):
RR : Rr : rr = 1 : 2 : 1
Phenotypic ratio:
Red : Pink : White = 1 : 2 : 1

Comment (Pattern of Inheritance):

1. Pea plant shows complete dominance, where one allele completely masks the other.
2. Antirrhinum shows incomplete dominance, where heterozygous condition produces an intermediate phenotype (pink).

or

(b) (i) Chromosomal disorders are caused due to abnormalities in the number or structure of chromosomes, whereas Mendelian disorders are caused by mutations in a single gene and follow Mendel's laws of inheritance. For example, Down syndrome is a chromosomal disorder, while haemophilia is a Mendelian disorder.

(ii) The phenomenon responsible is nondisjunction, in which chromosomes fail to separate during meiosis. The genetic disorder is Turner's syndrome. Individuals are phenotypically female but show short stature, underdeveloped ovaries, sterility, lack of secondary sexual characters, and a webbed neck.The karyotype is 45, XO.

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32. (a) (i) Draw the structure of an antibody molecule and label any four of its parts.

(ii) Differentiate between active and passive immunity. Write any three differences.

or

(b) (i) (I) Write the scientific names of the two species of filarial worms causing filariasis

(II) How do they affect the body of infected persons?

(III) How does the disease spread?

(ii) Mention the source and the role of the following in providing defence against infection in the human body:

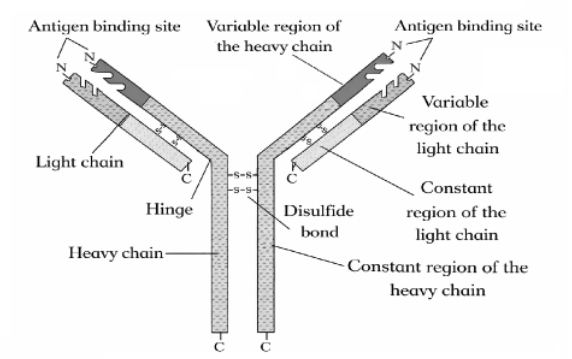
(I) Histamine

(II) Interferons

Ans :

(a)

(i)



(ii) The differentiate between active and passive immunity are as follows :

Active Immunity	Passive Immunity
Antibodies are produced by the body in response to antigen	Antibodies are received from outside
Develops slowly but provides long-lasting protection	Provides immediate but short-term protection
Immunological memory is present	No immunological memory
Example: Vaccination	Example: Antiserum / maternal antibodies

or

(b)

(i) I. The two species are Wuchereria bancrofti and Wuchereria malayi.

II. These worms live in lymphatic vessels and cause blockage, leading to swelling of body parts, especially legs and genital organs. This condition is called elephantiasis, resulting in thickening of skin and tissues.

III. The disease spreads through the bite of infected female Culex mosquito, which transmits the larvae from one person to another.

(ii) (I) Histamine :

Source : Mast cells (and basophils)

Role : Causes inflammation by increasing permeability of blood vessels, allowing immune cells to reach the site of infection

(II) Interferons :

Source : Virus-infected cells

Role : Protect non-infected cells from viral infection and inhibit viral replication.

33. (a) Briefly explain the events of fertilisation and implantation in an adult human female.

or

(b) (i) Arrange the following hormones in sequence of their secretion in a pregnant woman :

hCG; LH; FSH; Relaxin.

(ii) Mention the source and the functions of the above mentioned hormones.

Ans :

(a) Fertilisation : Fertilisation occurs in the ampullary–isthmic junction of the fallopian tube. It involves fusion of a sperm with the ovum to form a diploid zygote. During this process, the sperm undergoes capacitation and acrosomal reaction to penetrate the ovum. This restores the diploid chromosome number and determines the sex of the offspring.

Events after fertilisation : The zygote undergoes rapid mitotic divisions called cleavage to form a 2-cell, 4-cell stage and then a morula (8–16 cells). The morula develops into a blastocyst consisting of an outer trophoblast and inner cell mass.

Implantation : The blastocyst reaches the uterus and attaches to the endometrium. The trophoblast cells help in embedding the blastocyst into the uterine wall. This process is called implantation and leads to the establishment of pregnancy.

Significance : After implantation, placenta formation begins, ensuring nourishment and development of the embryo.

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(b) (i) FSH → LH → hCG → Relaxin

(ii) 1. FSH (Follicle Stimulating Hormone):
Source : Anterior pituitary gland
Function : Stimulates growth and maturation of ovarian follicles and secretion of oestrogen

2. LH (Luteinizing Hormone):
Source : Anterior pituitary gland
Function : Triggers ovulation and formation of corpus luteum; stimulates secretion of progesterone

3. hCG (Human Chorionic Gonadotropin) :
Source: Placenta (trophoblastic cells)
Function : Maintains corpus luteum during early pregnancy and ensures continued secretion of progesterone to sustain the endometrium

4. Relaxin :
Source : Corpus luteum of ovary and later placenta
Function : Relaxes pelvic ligaments, softens cervix, and facilitates parturition (childbirth)

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CBSE Examination Paper 2025

Class XII

Biology (044)

Time : 3 Hours **Max. Marks : 70**

General Instructions:

1. All questions are compulsory.
2. The question paper has five sections and 33 questions. All questions are compulsory.
3. Section—A has 16 questions of 1 mark each; Section—B has 5 questions of 2 marks each; Section—C has 7 questions of 3 marks each : Section—D has 2 case-based questions of 4 marks each; and Section—E has 3 questions of 5 marks each.
4. There is no overall choice. However, internal choices have been provided in some questions. A student has to attempt only one of the alternatives in such questions.
5. Wherever necessary, neat and properly labeled diagrams should be drawn.

SECTION-A

1. Mohit performed an analysis of two different soil samples from two areas A and B. He recorded these results :

Soil Sample A : Lignin 40%, Sugar 10%, Chitin 45%, Nitrogen 5%

Soil Sample B : Lignin 5%, Sugar 35%, Chitin 15%, Nitrogen 45%

Which of these is true about their rate of decomposition in both the soil?

(a) Soil A has a slower rate of decomposition than Soil B.
(b) Soil A has a faster rate of decomposition than Soil B.
(c) Both have the same rate of decomposition.
(d) No decomposition occurs in A and B.

Ans :

Soil A contains high lignin and chitin, which decompose slowly, while Soil B is rich in nitrogen and sugar that accelerate decomposition. Therefore, Soil A decomposes slower than Soil B.
Thus (a) is correct option.

2. Diameter of the pollen grain generally is

(a) 5 to 10 micrometer
(b) 10 to 15 micrometer
(c) 25 to 50 micrometer
(d) 50 to 100 micrometer

Ans :

Pollen grains, which are male gametophytes in flowering plants, typically have a diameter in the range of 25 to 50 micrometers. This size facilitates their function in reproduction.
Thus (c) is correct option.

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3. Menstrual cycle in human females consists of various events, Select the option that indicates the correct sequence of these events of menstrual cycle.

(a) Menstrual phase, Follicular phase, Luteal phase, Ovulatory phase.
(b) Luteal phase, Follicular phase, Ovulatory phase, Menstrual phase.
(c) Menstrual phase, Follicular phase, Ovulatory phase, Luteal phase.
(d) Follicular phase, Luteal phase, Menstrual phase, Ovulatory phase.

Ans :

The menstrual cycle begins with the menstrual phase (bleeding), followed by the follicular phase (follicle growth), ovulatory phase (egg release) and luteal phase (corpus luteum formation). This sequence supports ovulation and potential pregnancy.
Thus (c) is correct option.

4. A Dihybrid cross is done between two parent pea plants (pure line) who differ in two pairs of contrasting traits : Seed colour and seed shape.
In the F_2 generation the number of phenotypes and genotypes will be :

(a) phenotypes = 4; genotypes = 16
(b) phenotypes = 9; genotypes = 14
(c) phenotypes = 4; genotypes = 8
(d) phenotypes = 4; genotypes = 9

Ans :

A dihybrid cross of pure lines for two traits results in 4 phenotypes due to dominant and recessive combinations and 9 genotypes based on all possible allele pairings from heterozygous F_1 parents.

Cross between seed colour and seed shape

Parental ⇒ RRYY (Round and yellow) X rryy (Wrinkled and green)

↓

F_1 generation RrYy (Selfing of F_1)

↓

F_2 generation

♀ \ ♂	RY	Ry	rY	ry
RY	RRYY	RRYy	RrYY	RrYy
Ry	RRYy	RRyy	RrYy	Rryy
rY	RrYY	RrYy	rrYY	rrYy
ry	RrYy	Rryy	rrYy	rryy

The phenotypic ratio is:

9 : 3 : 3 : 1

(Round yellow) (Round green) (Wrinkled yellow) (Wrinked green)

Total phenotypes = 4

The Genotypic ratio

1 : 2 : 1 : 2 : 4 : 2 : 1 : 2 : 1

Total genotypes = 9.

Thus (d) is correct option.

5. RNA interference (RNAi) helps in making tobacco-plant resistant to a nematode (Meloidogyne incognita)

Choose the correct option that shows how RNAi is achieved :

(a) Preventing the process of translation of mRNA of the nematode.

(b) Preventing the process of replication of DNA of the nematode.

(c) Preventing the process of transcription of DNA of the plant.

(d) Preventing the process of replication of DNA of the plant.

Ans :

RNAi works by silencing a specific mRNA using complementary double-stranded RNA. This blocks translation of the target mRNA, thus preventing protein formation in the nematode. This mechanism provides resistance to the plant.

Thus (a) is correct option.

6. The sequence of nitrogenous bases in a segment of a coding strand of DNA is 5' - AATGCTAGGCCAC - 3'.

Choose the option that shows the correct sequence of nitrogenous bases in the mRNA transcribed by the DNA.

(a) 5' - UUACGAACCGAG - 3'

(b) 5' - AAUGCUAGGCCAC - 3'

(c) 5' - UAUGCUAGCCUG - 3'

(d) 5' - AACGUAGCGCAC - 3'

Ans :

The mRNA sequence is complementary to the DNA template strand and matches the coding strand (except uracil replaces thymine). Since the coding strand is 5' - AATGCTAGGCCAC - 3', the mRNA is 5' - AAUGCUAGGCCAC - 3'.

Thus (b) is correct option.

7. A man whose father was colour-blind marries a woman who had a colour-blind mother and normal father. What percentage of male children of this couple will be colour-blind?

(a) 25% (b) 0% (c) 50% (d) 75%

Ans :

Father XY × Mother X^CX

Children XX^C (Carrier female), XX (Normal female), X^CY Affected male, XY Normal male

The woman is a carrier (XcX), and the man is normal (XY). Their sons inherit the Y from the father and have a 50% chance of getting the Xc from the mother, making them colour-blind (XcY).

Thus (c) is correct option.

8. Evolution of modern man involves the following man-like primates. Choose the correct series of human evolution.

(a) Dryopithecus → Homo erectus → Australopithecines → Homo sapiens

(b) Australopithecines → Homo erectus → Neanderthal → Homo sapiens

(c) Australopithecines → Ramapithecus → Dryopithecus → Homo sapiens

(d) Homo erectus → Australopithecines → Homo sapiens → Neanderthal

Ans :

Human evolution followed the sequence: Australopithecines → Homo erectus → Neanderthal → Homo sapiens. Each species represents a transitional stage, with modern humans (Homo sapiens) emerging about 75,000–10,000 years ago after the Neanderthals.

Thus (b) is correct option.

9. GEAC stands for

(a) Genome Engineering Action Committee

(b) Ground Environment Action Committee

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(c) Genetic and Environment Approval Committee
(d) Genetic Engineering Approval Committee

Ans :

GEAC stands for Genetic Engineering Approval Committee. It is an Indian regulatory body under the Ministry of Environment, responsible for approving genetically modified organisms (GMOs) and products for research and commercial release.
Thus (d) is correct option.

10. Transplantation of tissues/organs to some patients often fails due to rejection... Which type of immune response is responsible for such rejections?
(a) Autoimmune response
(b) Humoral immune response
(c) Physiological immune response
(d) Cell mediated immune response

Ans :

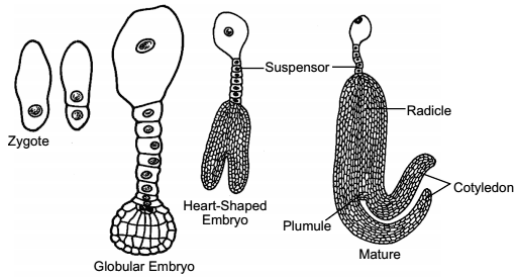
Rejection of transplanted organs is mainly due to cell-mediated immune response. T-lymphocytes recognize the graft as foreign and attack it. This response is not antibody-based like humoral immunity but driven by cells directly.
Thus (d) is correct option.

11. Amplification of gene of interest by using DNA polymerase may go up to
(a) 0.1 million times
(b) 1 million times
(c) 1 billion times
(d) 1 trillion times

Ans :

PCR (Polymerase Chain Reaction) enables exponential amplification of DNA. After ~40 cycles, a single DNA fragment can be amplified up to 1 trillion times, making it highly efficient for gene cloning and analysis.
Thus (d) is correct option.

12. The diagram shows labelling of four parts of a dicot embryo during development as P, Q, R, and S.



Choose the option that indicates correct labelling:
P Q R S
(a) Egg, Suspensor, Radicle, Cotyledon
(b) Zygote, Suspensor, Cotyledon, Plumule
(c) Egg, Radicle, Suspensor, Cotyledon
(d) Zygote, Suspensor, Cotyledon, Radicle

Ans :

The correct sequence is :
P = Zygote,
Q = Suspensor (connects embryo to parent),
R = Cotyledon (seed leaves),
S = Plumule (shoot tip).
These are key embryonic parts in dicot development.
Thus (b) is correct option.

13. **Assertion (A)** : Perisperm is a diploid tissue.
Reason (R) :Perisperm is the remains of nucellus which surrounds the embryo in certain seeds.
(a) Both (a) and (R) are true, and (R) is the correct explanation of (a).
(b) Both (a) and (R) are true, but (R) is not the correct explanation of (a).
(c) (a) is true, but (R) is false.
(d) (a) is false, but (R) is true.

Ans :

The perisperm forms from the nucellus, a diploid maternal tissue, and remains in some seeds. Hence, it is diploid. The reason correctly explains the assertion.
Thus (a) is correct option.

14. **Assertion (A)** : While working on Staphylococci, Alexander Fleming observed that *Penicillium notatum inhibits the growth of bacteria.
Reason (R) : The inhibiting chemical was commercially extracted and its full potential was established by Alexander Fleming.
(a) Both (a) and (R) are true and (R) is the correct explanation of (a).
(b) Both (a) and (R) are true, but (R) is not the correct explanation of (a).
(c) (a) is true, but (R) is false.
(d) (a) is false, but (R) is true.

Ans :

Fleming discovered penicillin's antibacterial effect, but it was Howard Florey and Ernst Chain who extracted and developed it for commercial use. So, the assertion is true, but the reason is incorrect.
Thus (c) is correct option.

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15. **Assertion (A)** : One of the properties of genetic code is degeneracy.
Reason (R) : Some amino acids can be coded by more than one codon.
(a) Both (a) and (R) are true and (R) is the correct explanation of (a).
(b) Both (a) and (R) are true, but (R) is not the correct explanation of (a).
(c) (a) is true, but (R) is false.
(d) (a) is false, but (R) is true.

Ans :

Degeneracy of the genetic code means multiple codons can encode the same amino acid. This reduces the effect of mutations. Hence, both assertion and reason are true and reason correctly explains the assertion.
Thus (a) is correct option.

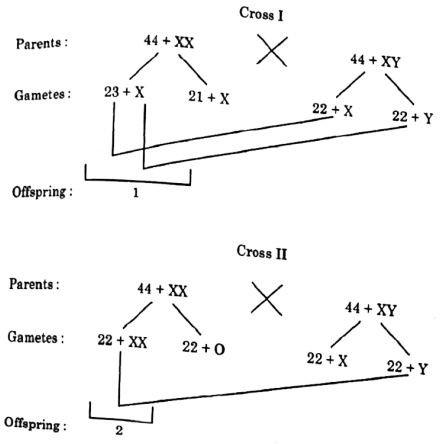
16. **Assertion (A)** : A bioreactor provides the optimal conditions for achieving the desired product by providing optimum growth conditions.
Reason (R) : The most commonly used bioreactors are of stirring type.
(a) Both (a) and (R) are true and (R) is the correct explanation of (a).
(b) Both (a) and (R) are true, but (R) is not the correct explanation of (a).
(c) (a) is true, but (R) is false.
(d) (a) is false, but (R) is true.

Ans :

Bioreactors do provide optimal growth conditions for microbial or cell cultures. Stirring-type bioreactors are common, but the reason doesn't explain how optimal conditions are achieved, so both are true but unrelated.
Thus (b) is correct option.

SECTION-B

17. Study the two different crossing given below:



Identify the abnormalities 1 and 2 in the offsprings of given crosses and distinguish between them.

Ans :

In Case I : The offspring is affected by a genetic disorder caused by the presence of an extra copy of an autosome.
The chromosomal combination is : 23 × (22 + X)
This condition arises due to trisomy of an autosome, leading to Down's syndrome. It occurs when an abnormal gamete (with 23 chromosomes, including an extra autosome and X) fuses with a normal gamete (22 + X or 22 + Y).
In Case II : The offspring has a trisomy of sex chromosome, where there is an extra X chromosome.
The chromosomal combination is:
(22 + XX) × (22 + Y)This results in a genetic disorder known as Klinefelter's syndrome, which occurs due to the fusion of an abnormal egg (containing two X chromosomes) with a normal sperm.

Comparison:

	Trisomy of Autosome		**Trisomy of Sex Chromosome**
1.	Involves an extra copy of an autosome.	1.	Involves an extra X chromosome.
2.	Caused by fusion of abnormal gamete (23 + X) with normal gamete (22 + X or 22 + Y).	2.	Caused by fusion of abnormal gamete (22 + XX) with normal gamete (22 + Y).

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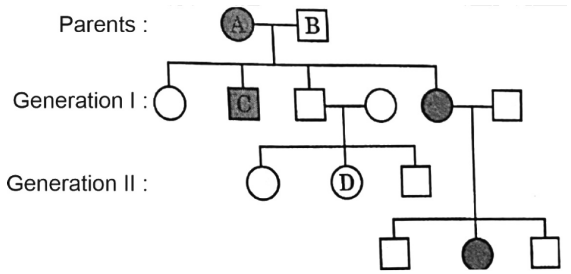
18. Study the pedigree analysis of Myotonic dystrophy given below :



Answer the following questions :
(a) Write genotype of A, B, C, and D.
(b) Identify whether the trait is :
(i) Sex linked or autosomal
(ii) Dominant or recessive

Ans :

(a) Genotypes :
1. Individual A = Aa (Affected, heterozygous)
2. Individual B = aa (Normal, homozygous recessive)
3. Individual C = Aa (Affected)
4. Individual D = aa (Normal)

(b) (i) The trait is autosomal, as both males and females are equally affected.

(ii) The trait is dominant, as affected individuals have at least one affected parent and the trait appears in every generation.

19. Attempt either (A) or (B):

(A) A patient with ADA deficiency requires periodic infusion of genetically engineered lymphocytes. Explain why such periodic infusion is required and also suggest a permanent cure for such ADA deficiency.

or

(B) Describe in brief any two techniques that can be utilised to transfer recombinant DNA into the host cell directly without using any vector.

Ans :

(A) ADA deficiency is caused by a missing enzyme, affecting the immune system. Infused lymphocytes have corrected ADA genes but do not divide permanently, so infusion is repeated.Permanent cure : Gene therapy using stem cells – introducing functional ADA gene into bone marrow stem cells, which then divide and produce ADA permanently.

(B) 1. Microinjection : DNA is directly injected into the nucleus of the host cell using a fine needle.

2. Gene Gun (Biolistic method) : DNA-coated gold or tungsten particles are shot into plant cells using high-velocity particles.

20. Student to Attempt either option (a) or (b):

(A) How are morphine and heroin related? Mention their effect on the human body.

or

(B)

(i) Name an alcoholic drink produced by microbes :
1. Without distillation : Wine, beer
2. With distillation : Whisky, brandy, rum

(ii) Explain how cyanobacteria can be used as bio-fertilizer :

Ans :

(A) Heroin (smack) is chemically diacetylmorphine, formed by acetylation of morphine. Both are opioid drugs, which are depressants. They slow down body functions like heart rate and breathing and are addictive substances affecting the central nervous system.

or

(B)

(i) 1. Wine and beer are made without distillation.
2. Whisky, brandy, and rum are made through distillation.

(ii) Cyanobacteria are autotrophic microbes found in both aquatic and terrestrial environments, many of which can fix atmospheric nitrogen. In paddy fields, they act as biofertilizers, enriching soil fertility by adding organic matter.

21. Attempt either option (A) or (B):

(A) Analyse the following ecosystems and discuss which will be more productive in terms of primary productivity :
A young forest, a natural old forest, a shallow polluted lake*

(B) Differentiate between Net Primary Productivity (NPP) and Gross Primary Productivity (GPP) in an ecosystem.

Ans :

(A) A natural old forest will be most productive due to high biodiversity and biomass. A young forest is moderately productive, while a shallow polluted lake has lowest productivity due to pollution and reduced photosynthesis.

(B)
1. GPP : Total rate of photosynthesis, i.e., all energy captured by producers.
2. NPP : GPP minus energy used in respiration (R).
NPP = GPP – R
3. NPP represents the available biomass for consumption by herbivores and decomposers.

SECTION-C

22. (a)

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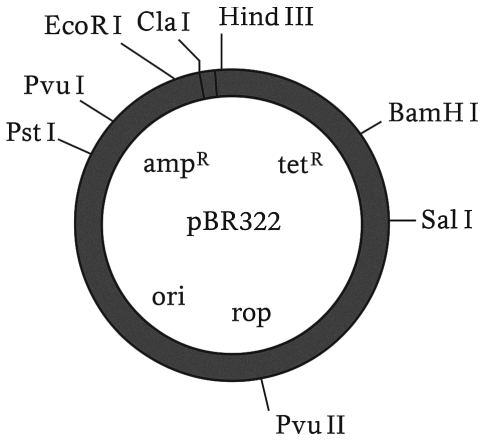


Explain the importance of 'ori' and 'rop' in the E. coli* cloning vector shown in the above diagram.

(b) Differentiate between exonucleases and endonucleases.

Ans :

(a) 1. 'ori' (origin of replication) : It is the DNA sequence from where replication starts. It is essential for cloning because any foreign DNA linked to this sequence will replicate within the host cell. It also controls the copy number of the plasmid.

2. 'rop' : This gene codes for proteins involved in replication. It helps regulate the number of copies of the plasmid within the bacterial cell. It also contains a restriction site for *Pvu II* enzyme.

(b) Difference between Exonucleases and Endonucleases are as follows :

Exonucleases	**Endonucleases**
Restriction enzymes that remove nucleotides from the ends of DNA.	Restriction enzymes that make cuts at specific positions within the DNA.
e.g., Exonuclease I, Exonuclease II	e.g., Eco RI, Bam HI, etc.

23. The great German naturalist and geographer Alexander Von Humboldt observed that within a region, species richness increased with explored area, but only up to a limit.

(a) Construct a graph and write an equation.

(b) Also write various values of Z (regression coefficient).

Ans :

(a) Graph & Equation : The species-area relationship is represented by the equation :

$\log = \log C + Z \log A$

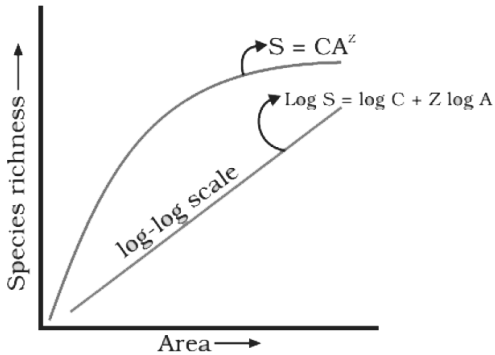
Where:

S = species richness

A = area explored

C = constant

Z = slope or regression coefficient



The graph is a curve on a log-log scale that becomes linear, showing increasing species richness with area until it plateaus.

(b) Values of Z (regression coefficient):

1. For most taxonomic groups in a region, Z = 0.1 to 0.2
2. For large areas like continents, Z = 0.6 to 1.2
3. For frugivorous birds and mammals in tropical forests, Z = 1.15

24. Shyam and Radha are expecting their first child with Radha being in her second month of pregnancy with no complications. Shyam's family has a history of cystic fibrosis while Radha's family has a history of Down's syndrome, leading to a concern that the baby may have one of these conditions.

(a) Suggest and explain a way of testing if their baby is at risk for any genetic disorders.

(b) In case of presence of one or both of the abnormalities and posing a risk to the mother's health, mention one possible option for them to consider. Is that option safe for Radha at the current gestational age? Justify.

(c) Under the what condition is the process mentioned in (b) is illegal?

Ans :

(a) Shyam and Radha's baby can be tested for genetic disorders using amniocentesis, a prenatal diagnostic technique. A small sample of amniotic fluid is extracted from the uterus

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and analyzed to detect genetic abnormalities in fetal cells.

(b) If any genetic disorder and risk to the mother's health are identified, medical termination of pregnancy (MTP) is an option. Since Radha is in her second month, the procedure is considered safe and legally permitted as it falls within the first 12 weeks of pregnancy.

(c) MTP becomes illegal if it is performed solely because the fetus is female, or if it is carried out by unqualified medical personnel.

25. (a) Write the palindromic nucleotide sequence for following sequence of DNA segment :
$5' - GAATTC - 3'$

(b) Name the restriction endonuclease that recognizes this sequence.

(c) How are sticky ends produced? Mention their role.

Ans :

(a) The palindromic sequence of the given DNA segment is :

$$3' - CTTAAG - 5'$$

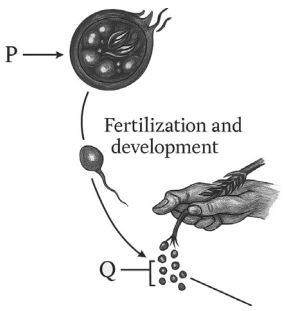
(b) The restriction enzyme EcoRI recognizes the sequence :

$$5' - G\downarrow AATTC - 3'$$

$$3' - CTTAA\uparrow G - 5'$$

(c) Sticky ends are formed when restriction enzymes cut DNA slightly away from the center of palindromic sequences, creating overhanging single-stranded ends. These ends help in joining DNA fragments by forming hydrogen bonds between complementary base pairs, facilitating recombinant DNA formation.

26. Study a part of life cycle of Plasmodium given below :



Answer the following questions:

1. Name the infective stage of Plasmodium that is stored in the female Anopheles mosquito.
2. Where does fertilization and development of parasite take place?
3. Identity labels is P and Q in the given diagram.
4. Asexual and sexual phase of the life cycle of the takes place in two different hosts. Write their names.

Ans :

In the life cycle of Plasmodium, the diagram shown represents the sexual phase of the parasite which occurs in the female Anopheles mosquito (definitive host).

1. Fertilization takes place inside the mosquito's gut when male and female gametes fuse to form a zygote.
2. The zygote becomes an ookinete, which penetrates the mosquito's gut wall to form an oocyst.
3. The oocyst undergoes multiple divisions, releasing thousands of sporozoites.
4. Parasite reproduces asexulally in - Human hepatocytes and RBCs.
   Parasite reproduces asexulally in - Gut of female Anopheles mosquito.

These sporozoites migrate to the salivary glands of the mosquito, ready to be injected into a new human host during a mosquito bite, beginning the asexual cycle in humans.

27. Compare and contrast convergent and divergent evolution.

Ans :

Convergent Evolution	**Divergent Evolution**
Originates from different ancestors	Originates from a common ancestor
Leads to development of analogous structures (same function, different origin)	Leads to formation of homologous structures (same origin, different function)
Organisms become more similar in appearance over time	Organisms become more different in appearance over time
Structures are anatomically different	Structures are anatomically similar
Examples : Hearts or brains of vertebrates; thorns of Bougainvillea and tendrils of Cucurbita	Examples : Flippers of penguins and dolphins; eyes of Octopus a

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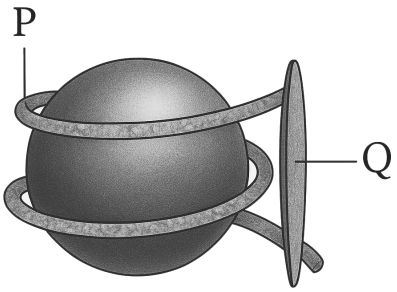
28. Study the diagram given below and answer the questions that follow :



(a) Identify the structure shown in the above figure.
(b) Identify the labels P and Q.
(c) Write the nature of histone proteins.
(d) Distinguish between Euchromatin and Heterochromatin.

Ans :

(a) The diagram illustrates a nucleosome, which is the fundamental unit of chromatin structure.
(b) P indicates DNA.
Q denotes the histone octamer.
(c) Histone proteins are basic in nature due to the presence of positively charged amino acids like lysine and arginine.
(d) Difference between Euchromatin and Heterochromatin:

	Euchromatin		**Heterochromatin**
(i)	Loosely arranged chromatin	-	Densely packed chromatin
(ii)	Appears lightly stained	-	Appears darkly stained
(iii)	Actively transcribed	-	Transcriptionally inactive

SECTION-D

29. Read the following passage and answer the questions that follow:
In nature, we rarely find isolated, single individuals of any species; majority of them live in groups in a well-defined geographical area, share or compete for similar resources, potentially interbreed and thus constitute a population. The population has certain attributes whereas, an individual organism does not. A population at a given time is composed of individuals of different ages. The size of the population tells us a lot about its status in the habitat. Whatever ecological processes we wish to investigate in a population, be it the outcome of competition with another species, the impact of the predator or the effect of pesticide application, we always evaluate in terms of any change in the population size. The size, in nature, could be low or go into millions. Population size, technically called population density (N) need not necessarily be measured in numbers only. The size of a population for any species is not a static parameter. It keeps on changing with time depending on various factors including food availability, predation pressure and adverse weather.

(a) The Monarch butterfly is highly distasteful to its predator because of a special chemical present in its body. How does the butterfly acquire this chemical?
(b) If population density at a time t + 1 is 800, Emigration = 100, Immigration = 200, Natality = 200 and Mortality = 150, calculate the population density at time t and comment upon the type of age pyramid that will be formed in this case.
Student to attempt either sub-part (c) or (d):
(c) What is the difference in a method of measuring population density in an area if there are 200 carrot grass plants to only single huge banyan tree?

or

(d) Name two methods to measure the population density of tigers.

Ans :

(a) The Monarch butterfly acquires the chemical during its caterpillar stage by feeding on a poisonous weed. The toxin from the plant gets stored in its body, making it unpalatable to predators.
(b) We use the formula :

$N_{t+1} = 800, E = 100$

$I = 200, D = 150, B = 200$

$N_{t+1} = N_t + [(B + I) - (D + E)]$

$800 = N_t + (200 + 200) - (150 + 100)$

$800 = N_t + 400 - 250$

$N_t = 800 - 150 = 650$

Since $N_t + 1 > Nt$, population is increasing, so it will form an expanding age pyramid.

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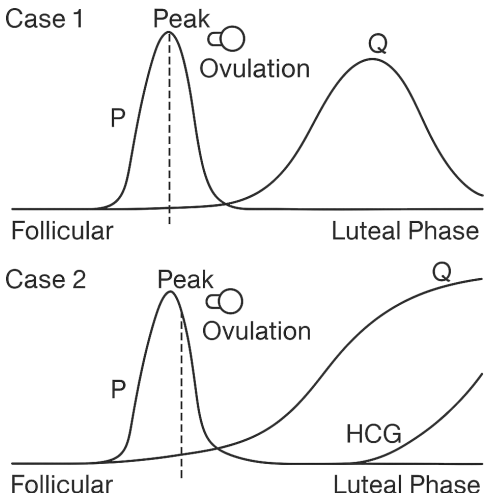
(c) For the carrot grass, population density is measured by number.
But for banyan trees, which are few but large, measuring by number is misleading. In such cases, biomass or percent cover is a better indicator of population size and ecological role.

or

(d) Two methods used in tiger census :
1. Pug mark tracking
2. Fecal pellet analysis

30. Study the graphs given below for Case 1 and Case 2 showing different levels of certain hormones and answer the questions that follows:



(a) Which hormone is responsible for the peak observed in Case 1 and Case 2? Write one function of that hormone.
(b) Write changes that take place in the ovary and uterus during the follicular phase.
(c) Name the hormone Q of Case 2. Write one function of hormone Q.
(d) Which structure in the ovary will remain functional in Case 2? How is it formed?

Ans :

(a) The hormone responsible for the peak in both cases is Luteinizing Hormone (LH).
Function : LH surge triggers ovulation — the release of a mature ovum from the Graafian follicle.

(b) 1. In ovary : Follicular phase involves maturation of ovarian follicles under the influence of FSH. One follicle becomes dominant (Graafian follicle).
2. In uterus : Endometrial lining begins to regenerate and thicken, preparing for potential implantation.Student to attempt either (c) or (d):

(c) Hormone Q is Progesterone.
Function : Maintains the endometrial lining of the uterus, supports implantation and pregnancy.

or

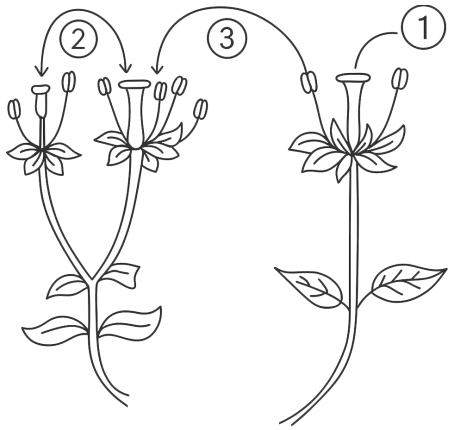
(d) 1. The structure is the Corpus luteum.
2. It is formed from the ruptured Graafian follicle after ovulation. In Case 2 (pregnancy), it is maintained by hCG hormone and continues to secrete progesterone.

SECTION-E

31. Student to attempt either option-(A) or (B):

(A) (a) Distinguish between the two cells enclosed in amature male gametophyte of an angiosperm.

(b) Study the diagram given below showing the modes of pollination. Answer the questions that follow.



(i) The given diagram shows three methods of pollen transfer in plants. Examine them carefully and write the technical terms used for pollen transfer in methods '1', '2' and '3'.
(ii) How do the following plants achieve pollination successfully?
(a) Water lily
(b) Vallisneria
(iii) Write advantages of pollen transfer method '3'.

or

(B) Given below is the diagram of human ovum surrounded by a few sperms. Observe the diagram and answer the questions that follows:

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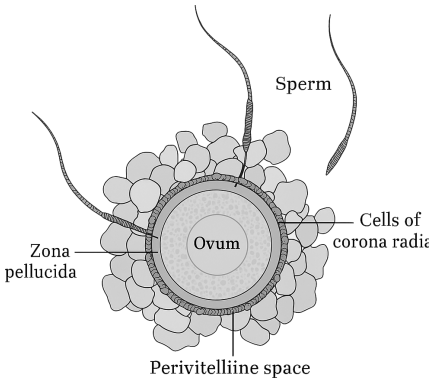

(i) Compare the fate of sperms 'P', 'Q' and 'R' shown in the diagram,
(ii) Write the role of Zona pellucida in this process.
(iii) Analyse the changes occurring in the ovum after the entry of sperm.
(iv) How acrosome and middle piece are able to play an important role in human fertilization?

or

Ans :

(A) (a) Pollen grains are male gametophytes. On maturity, they contain two cells : generative and vegetative.

Generative Cell	**Vegetative Cell**
Smaller in size	Larger in size
Spindle-shaped, dense cytoplasm, and a nucleus	Large, irregular nucleus
Floats in vegetative cell's cytoplasm	Contains food reserves

(b)
(i) 1. Method 1 is autogamy, i.e. pollination within the same flower.
2. Method 2 is geitonogamy, where pollen moves to another flower of the same plant.
3. Method 3 is xenogamy, where pollen is transferred to a flower of a different plant.

(ii) 1. In water lily, flowers rise above water and pollination occurs via insects or wind.
2. In Vallisneria, the female flower floats to the surface; male flowers or pollen are water-borne and some reach the stigma through water currents.

(iii) 1. Xenogamy allows pollination between genetically different plants.
2. It promotes genetic variation, aiding better survival.

or

(B) (i) Sperm 'P' enters the ovum by crossing the zona pellucida and fertilizes it. Sperms 'Q' and 'R' stay outside due to zona changes that block further entry.
(ii) Zona pellucida undergoes changes to block other sperms once one enters.
(iii) Sperm triggers completion of meiosis-II in the ovum, forming a second polar body and haploid ovum. The sperm and ovum nuclei fuse to form a zygote.
(iv) The acrosome contains enzymes to digest the zona pellucida for entry, while the middle piece provides energy for motility via mitochondria

32. Attempt either (A) or (B):
(A) Answer the following:
(i) What is MALT? Where is it located?
(ii) Explain cytokine barriers :
(iii) Name the diagnostic test for AIDS. On what principle does it not work?
(iv) Role of bone marrow and thymus in the immune system :

or

(B) (i) Fill 'H', 'I', 'J', 'K', 'L', and 'M' in following table with suitable words:

	Chemical/ Bioactive Molecule	**Micro-organism**	**Category**	**Use**
(a)	Butyric acid	H	I	Important applications in food, chemical & pharma industry
(b)	J	Monascus purpureus	K	Inhibit cholesterol biosynthesis
(c)	Cyclosporin A	L	Fungus	M

(ii) Why are baculoviruses used as biological control agents?

Ans :

(A) (i) MALT stands for Mucosa-Associated Lymphoid Tissue.It is located in mucosal linings of respiratory, digestive, and urogenital tracts. It provides immune defense against pathogens entering through mucosal surfaces.

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- ✓ Same pattern followed

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(ii) Cytokine barriers are proteins secreted by cells of the immune system. Example: Interferons are released by virus-infected cells to protect neighboring cells from infection by interfering with viral replication.

(iii) 1. Diagnostic test : ELISA (Enzyme Linked Immunosorbent Assay)
2. It does not work during the window period, when the virus is present but antibodies are not yet detectable.

(iv) 1. Bone marrow : Produces all types of blood cells including B-lymphocytes, which mature there.
2. Thymus : T-lymphocytes mature here.Together, they enable the development of specific immunity by producing antibody- and cell-mediated responses.

or

(B) (i)

	Chemical/ Bioactive Molecule	Micro-organism	Category	Use
(a)	Butyric acid	(H) Clostridium butylicum	(I) Bacteria	Widely used in food, chemical, and pharmaceutical industries
(b)	(J) Statins	Monascus purpureus	(K) Fungus	Used to lower cholesterol levels
(c)	Cyclosporin A	(L) Trichoderma polysporum	Fungus	(M) Acts as an immunosuppressant in organ transplantation procedures

(ii) Baculoviruses are effective biocontrol agents as they specifically target insects and other arthropods.
1. These viruses are highly species-specific and ideal for narrow-spectrum insecticidal use.
2. They cause no harm to plants, mammals, birds, fish, or beneficial insects.
3. They are preferred when ecological sensitivity is critical or when integrated pest management (IPM) strategies are in place to protect helpful insect populations.

33. Student to attempt either option-(A) or (B):

(A) (i) Haemophilia and red green colour-blindness is usually observed in men. Why?

(ii) Perform a cross(es) where haemophilic daughter(s) and haemophilic son(s) are produced in same ratio.

or

(B) (i) Where do transcription and translation occur in bacteria and eukaryotes respectively?

(ii) Draw a labelled schematic sketch of replication fork of DNA.

(iii) A DNA segment has a total of 1000 nucleotides, out of which 240 of them are Adenine containing nucleotides. How many pyrimidines bases this segment possesses?

Ans :

(A) (i) Haemophilia and colour blindness are X-linked recessive disorders.Since males have only one X chromosome, the presence of a single defective gene leads to the disorder.Females, having two X chromosomes, are usually carriers and remain unaffected, while males are more likely to express the disorder.

(ii) To get equal chances of haemophilic daughters and sons, the cross should be:

Parents Father (♂) Mother (♀)

XX × XY

(Haemophilic) (Carrier for haemophiliia)

F_1 generation XX XY XY

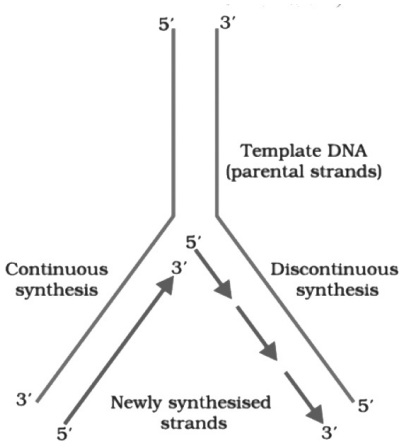
50% of daughter haemophilic — 50% of sons haemophilic

or

(B)

(i) 1. In prokaryotes, both transcription and translation occur in the cytoplasm simultaneously.
2. In eukaryotes, transcription occurs in the nucleus, and the processed mRNA is transported to the cytoplasm for translation.

(ii)



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(iii) According to Chargaff's Rule:

$$A = T \text{ and } G = C$$

Given :

$$A = 240$$

So, $T = 240$

Now,

$$\text{total nucleotides} = 1000$$

$$A + T + G + C = 1000$$

$$240 + 240 + G + C = 1000$$

$$G + C = 520$$

Since $G = C \rightarrow G$

$= 260$ and $C = 260$

Total Pyrimidines $= T + C = 240 + 260$
$= 500$ necleotides

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CHAPTER 1

SEXUAL REPRODUCTION IN FLOWERING PLANTS

SUMMARY

1. FLOWER

A typical flower is a highly modified condensed shoot that is essentially meant for the purpose of performing the process of sexual reproduction in plants. A flower is mainly composed of four different whorls Calyx,Corolla , Andorecium (male reproductive unit) and Gynoecium (Female reproductive unit). These are also known as floral appendages.

1.1 Flower Structure

The **important parts of a flower** are (a) Pedicel, (b) Receptacle, (c) Thalamus, (d) Calyx, (e) Corolla, (f) Androecium and (g) Gynoecium.

In the flower **androecium** consists of **stamens**. Statmen represents **male reproductive organs** of flower while **gynoecium** forms the **female reproductive organs**.

1.2 Sexual Reproduction in Angiospermic Plants (Flowering Plants)

It takes place with the help of flower. Flower is therefore the most important reproductive **part** of the plant and in **site** of sexual reproduction. Flower is a **modified shoot**.

2. PRE-FERTILIZATION : THE STRUCTURES AND THE EVENTS

The events which occur before the fertilisation are called pre-fertilisation events. Several hormonal and structural change in plants led to the differentiation and further development of the floral primordium.

Inflorescences are formed which bear the floral buds and then the flowers. In the flower, the androecium (male reproductive part) and gynoecium (female reproductive part) differentiate and develop to form male and female gametophyte.

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2.1 Stamen

Stamen is the male reproductive part of the flowers. It consists of 2 parts **anther** and **filament**-long slender stalk. **Pollen grains** are produced in the bilobed anther.

2.2 Anther

The anther is bilobed. Each lobe has two theca, hence called **dithecus**. A groove separates them. The structure of anther is **tetragonal**. Four **microsporangia** lie at corners and in each lose of anther, there are two **pollen sacs**.

2.3 Structure of Microsporangium

A typical microsporangium is surrounded by four wall layers, i.e. the epidermis, endothecium, middle layers and the tapetum. Tapetum **nourishes** the pollen but all other layers are protective in function and help in dehiscence of anther to release pollen grains.

2.4 Microsporogenesis

A young anther consists of homogenous mass of undifferentiated meristematic cells surrounded by an epidermis. It is called **sporogenous tissue**. A microsporangium contains sporogenous cells which divide **mitotically** and increases their number before they function as **Potential Mother Cell (PMC)**. Each pollen mother cell divides **meiotically** and consequently, four **microspores** are formed from each PMC. All the four microspores remain enclosed in a common wall. This four celled organisation is called **tetrad**.

2.5 Development of Male Gametophyte (Pollen Grain)

The pollen grains, on reaching stigma germinate and intine comes out through the germ pore to form pollen tube. The tube cell dies and generative cell undergoes mitotic division to form **two male gametes**. One of the male gametes fuses with the egg cell and other with the polar nuclei to complete the process of fertilization. Pollen may cause **allergy** and **bronchial afflictions** in humans.

The pollen grain is the **first cell** of the **male gametophyte**. It produces two male gametes. Both male gametes are discharged into the **embryo sac**. The male gametophyte is formed by **microsporogensis**. It occurs inside the **stamen** of **anther.**

Pistil

Three parts of a pistil or carpel are **ovary, style** and the **stigma**.

Ovule (Microsporangium)

The ovules are found in the ovary. The ovules has a stalk that is known as the **funicle** and an opening called **micropyle** as well as two protective layers called **integuments**. The **nucellus** is central tissue of ovule. The differentiation of **archesporium** occurs in this part of ovule.

2.6 Development of Female Gametophyte: Mgasporogenesis

A cell of archesporium is called the **megaspore mother cell**. It divides meiotically (reduction division). One of the megaspores forms the functional **embryo sac** or the **female gametophyte**. Mature embryo sac is seven celled but it **is eight** nucleate. Towards the **chalazal end** are the **antipodal cells**. At the micropylar end is **egg apparatus** having 2 **synergids** and one **egg cell**. Two polar nuclei lie in the central part of embryo sac.

The Female Gametophyte (Embryo sac)

It is eight nucleate, containing one egg cell and two synergids at the micropylar end, three antipodal cells at the chalazal end and **two polar** or **secondary nuclei**. After fertilization, the zygote divides and redivides to produce a **proembryo** whereas the secondary nucleus forms a triploidy endosperms.

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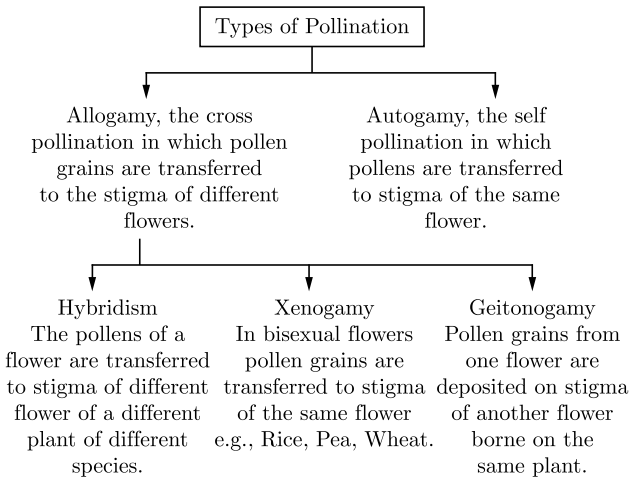
3. POLLINATION

It is defined "as the transfer of pollen grains and their deposition onto stigmatic surface." **Agents/ Agencies of Pollination: Wind, water, insects, birds** and **bats** help in pollination in flowers.

Types of Pollination



3.1 Hydrophily

The cross pollination by water is called hydrophily. It occurs in **aquatic plants**. It is two types :

1. Hypohyetrphily
2. Ephdrophily

Example : Zostera, Vallisneria and Ceratophyllum

3.2 Entomophily

Pollination by insects is known as entomophily.
Example: Salvia and Euphorbia.

3.3 Anemophily

Pollination by wind is termed as anemophily.
Example: Maize and coconut palm, apple, peach, date palm, grasses and cannabis.

3.4 Pollen Pistil Interaction

The geitonogamy-This involves all the reactions or events when pollen falls on stigma to the entrance of pollen tube into the embryo sac. If pollination is compatible, then double fertilization takes place. Its products are **zygote** (2N) and tripled **primary endosperm nucleus** (PEC, 3N). Zygote forms the **embryo** but PEC develops into **endosperm**.

3.5 Double Fertilization

Pollen grains **germinate on** the stigma. The nucleus of the pollen grain divides to produce **vegetative** and **generative cells** and later on male gametes. One of the male gametes fuses with egg cell. It is called **syngamy**. The other nucleus fuses with secondary diploid nucleus. There is fertilization at two places. It is called **double fertilization**. Entry of pollen tube into ovule may occur by 3 routes: **progamy, chalazogamy** and **mesogamy**.

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4. POST FERTILIZATION :STRUCTURE AND EVENTS

These involve **embryo formation, endosperm formation, seed** as well as the **fruit formation**. These events take place soon after the double fertilisation.

4.1 Endosperm

Endosperm development precedes embryo development and It many be of three types: **helobial, cellular** and **nuclear.**

5. DEVELOPMENT OF EMBRYO : EMBRYOGENY

The **pro-embryo** finally develops into an embryo. It gives rise to hypocotyl, radicle, epicotyl, plumule and cotyledons. It gets its food from the **nucleolus** and **perishes** ultimately; remains as a thin layer outside endosperm and is referred to as the **perisperm**. Changes in tissue outside embryo sac leads to formation of the seed. It has two coats: **taste** and **tegmen**. Ovary ripens into the **fruits**.

6. EMBRYO OF MONOCOT AND DICOT

Mature dicot embryo has 2 **cotyledons** and **embryonal axis** with epicotyl and hypocotyl. The embryo of monocotyledons has only one **cotyledon**. After fertilization, the ovary is developed into the fruit. The ovules develop into **seeds**.

7. SEEDS

Spermology is "the study of seeds". Fruits contain **seeds**. The seeds may be **endospermic (alubuminous)** e.g., maize wheat, castor, coconut etc. or **non endospermic (ex-albuminous)** e.g., almond, gram seed as well as the bean seed. Seeds of angiosperms fall into 2 groups: 1. **monocotyledonous seeds** and 2. **dicotyledonous seeds**.

8. FRUIT

Fruit is "the ripe ovary of the flower". This type of fruit is called **true fruit**. However, other floral parts may also take part in the formation of fruit. It then become a **false fruit**.

9. SOME IMPORTANT DEFINATIONS

1. **Apomixis and Polyembryony:** Formation of seeds without fertilization.
2. **Polyembroyony** is "the occurrence of more than one embryo in a seed." ex glasses.
3. **Parthenocarpy:** It is the phenomenon in which "fruit develop in unfertilized flowers, such fruits are seedless fruits". ex Banana.

OBJECTIVE QUESTIONS

1. Thalamus is edible part of:
(a) Annona (b) Apple
(c) Orange (d) All of these

Ans : **OD 2024, 2017**
The edible part of apple is thalamus. In orange, it is mesocarp while in annona it is aril.
Thus (b) is correct option.

2. Cleistogamous flowers are always:
(a) Self-Pollinated (b) Cross pollinated
(c) Both (d) None

Ans : **OD 2017**
Cleistogamy is a type of automatic self pollination of certain plants that can propagate by using non-opening, self-pollinating flowers. It is more common in grass family. Other examples are peanuts, peas etc.
Thus (a) is correct option.

3. Acetabularia is a type of:
(a) Bacteria
(b) Algae
(c) Protozoa
(d) Single cell protein

Ans : **OD 2017**
Acetabularia is a genus of green algae in the family polyphysaceae. It is a single-celled organism but gigantic in size and complex in form making it excellent modal organism for studying cell biology.
Thus (b) is correct option.

4. Central cell of embryosac is:
(a) primary nucleus
(b) secondary nucleus
(c) synergid
(d) both (a) and (b)

Ans : **OD 2016**
The central cell of embryosac is called as secondary nucleus. This nucleus fuses with second male gamete during fertilization to from triploidy primary endosperm nucleus (PEN), that give rise to endosperm of seed.
Thus (b) is correct option.

5. Aril is edible part of:
(a) Annona (b) Apple
(c) Orange (d) all of these

Ans : **OD 2016**
Aril is a edible part of annona. In orange, it is mesocarp while in apple, it is thalamus.
Thus (a) is correct option.

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6. Hydrophilic pollination occurs in:
(a) Eichornea (b) Lotus
(c) Hydrilla (d) Both a and c

Ans : OD 2016
Hydrophilic pollination occurs in both eichornea and hydrilla, while in lotus pollination is performed by insects.
Thus (d) is correct option.

7. Aril is edible in which of the following fruits ?
(a) Myristica (b) Litchi
(c) Annona (d) All of these

Ans : OD 2016
In all of the given options aril is an edible part of the fruit. It is an specialised out growth from a seed that partly or completely covers the seed.
Thus (d) is correct option.

8. How many chromosomes are present in endosperm ?
(a) n (b) $2n$
(c) $3n$ (d) Both (a) and (c)

Ans : OD 2013
Endosperm contain three sets of chromosome i.e. they are triploidy ($3n$) in nature. It is formed by fusion of second male gamete with the two polar nuclei or secondary nucleus in the central cell.
Thus (c) is correct option.

9. Anemophilous flowers are usually:
(a) attractive (b) small
(c) colourless (d) both (b) and (c)

Ans : OD 2013
Those flowers which are pollinated by wind are called Anemophilous flowers. Such flowers are small, colourless and inconspicuous.
Thus (d) is correct option.

DIRECTION : For the following question nos. 10 to 12 a passage is given. Read carefully the passage and select the correct answer out of given four option:

In the case of plants pollen grain contains male gametophyte. Pollen grains are variously articulated, but basically spherical in shape. They have two layers-outer one is Exine and inner one is Intine. A mature pollen grain has two cells-Vegetative cell and Generative cell. The nucleus of generative divides and forms two male gametes. Pollen grains are rich source of protein. Vitamins and minerals also. Pollen of some of the plants may cause allergy leading to bronchitis.

10. Pollen grains represent:
(a) Saprophyte (b) Gametophyte
(c) Male Gametophyte (d) None of these

Ans : OD 2013
Pollen grain is a microscopic body, found on flowers that contain male gametophyte.
Thus (c) is correct option.

11. The wall of pollen grain is:
(a) Single layered (b) Double layered
(c) Triple layered (d) Multilayered

Ans : OD 2013
The wall of pollen grain is made up of two layers, outer exine and inner intine.
Thus (b) is correct option.

12. Pollen grain may be:
(a) Gametophyte (b) Articulated
(c) Allergent (d) All of these

Ans : OD 2013
Pollen of some plants acts as allergent. They cause bronchitis in allergic persons.
Thus (c) is correct option.

13. What is fertilisation?
(a) Fusion of egg with male nuclei
(b) Fusion of egg with secondary nucleus
(c) Fusion of egg with synergid
(d) None of these

Ans : OD 2012
The process of fusion of egg with male pro-nucleus is called as fertilization. In it, haploid male and female gametes fuse to form a normal diploid offspring.
Thus (a) is correct option.

14. Anemophily is pollination by:
(a) Birds (b) Bats
(c) Snails (d) Wind

Ans : OD 2011
The process of pollination by wind is termed as anemophily. Such flowers are called as anemophilous flowers. They are inconspicuous, devoid of scent etc. eg. grass.
Thus (d) is correct option.

15. Entomophily is the pollination by:
(a) Birds (b) Bats
(c) Wind (d) Insects

Ans : OD 2010
Pollination by insect is termed as entomophily. Insect pollinated flowers are usually bright coloured. Scented and have nectar that attracts

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insects towards them.
Thus (d) is correct option.

16. Which one forms endosperm after fusion with male gamete ?
(a) Oosphere
(b) Synergids
(c) Antipodals
(d) Secondary nucleus

Ans : OD 2024, 2009
Endosperm is formed from the primary endosperm nucleus. Its formation starts before the formation of embryo. Primary endosperm nucleus is produced by fusion of secondary nucleus and second male gamete. The endosperm is thus tripled (3n).
Thus (d) is correct option.

17. Attractants and rewards are required for
(a) anemophily (b) entomophily
(c) hydrophily (d) cleistogamy

Ans : COMP 2006
Attractants and rewards are required for entomophily (insect pollination). Flowers produce specific odour and nectar to attract the insect for effective pollination. Entomophilous flowers are large with bright colours.
Thus (b) is correct option.

18. A dioecious flowering plant prevents both
(a) autogamy and xenogamy
(b) autogamy and geitonogamy
(c) geitonogamy and xenogamy
(d) cleistogamy an xenogamy

Ans : OD 2008
Dioecious flowering plants contain unisexual flower. In dioecious condition two types of unisexual flowers occur on different plants.
Hence, it does not favour autogamy and geitonogamy because autogamy takes place in bisexual flowers and geitonogamy takes place between different flower of the same plant.
Thus (b) is correct option.

19. Functional magaspore in an angiosperm develops into
(a) ovule (b) endosperm
(c) embryo sac (d) embryo

Ans : DELHI 2011
In angiosperms, functional magaspore develops into an embryo sac. The functional megaspore is the first cell of female gametophyte.
Thus (c) is correct option.

20. Double fertilisation is exhibited by
(a) gymnosperms (b) algae
(c) fungi (d) angiosperms

Ans : SQP 2007
Double fertilisation is the characteristic feature of angiosperms. In this type of fertilisation one male gamete fuses with an egg and forms zygote. The second male gamete fuses with diploid **secondary** nucleus of central cell to form a triploidy primary endosperm nucleus.
Thus (d) is correct option.

21. Which one of the following statements is not true?
(a) Exine of pollen grains is made up of sporopollenin.
(b) Pollen grains of many species cause severe allergies.
(c) Stored pollen in liquid nitrogen can be used in the crop breeding programmes.
(d) Tapetum helps in the dehiscence of anther.

Ans : OD 2005
Tapetum is the inner layer of microsporangium (anther) which provides nourishment to developing pollen grain after meiotic cell division.
Thus (d) is correct option.

22. Seed formation without fertilisation in flowering plants involves the process of
(a) budding
(b) somatic hybridisation
(c) apomixis
(d) sporulation

Ans : FOREIGN 2013
Apomixis is a special mechanism found in flowering plants to produce seeds without fertilisation. It is a type of asexual reproduction which mimics the sexual reproduction and is commonly found in Citrus varieties.
Thus (c) is correct option.

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23. Proximal end of the filament of stamen is attached to the
(a) connective (b) placenta
(c) thalamus or petal (d) anther

Ans : COMP 2015
A typical stamen consist of anther and filament. The proximal end of filament is attached to thalamus or petal of the flower whereas distal end bears anther.
Thus (c) is correct option.

24. The coconut water from tender coconut represents
(a) fleshy mesocarp

(b) free-nuclear proembryo
(c) free-nuclear endosperm
(d) endocarp

Ans : **OD 2010, DELHI 2012**
Coconut milk represents free-nuclear endosperm where the division of primary endosperm nucleus is not followed by formation of cell walls (cytokinesis) thus all nucleus remain free in liquid form. It is rich in plant hormone cytokinin.
Thus (c) is correct option.

25. Cotyledon of maize grain is called
(a) coleorhiza (b) coleoptile
(c) scutellum (d) plumule

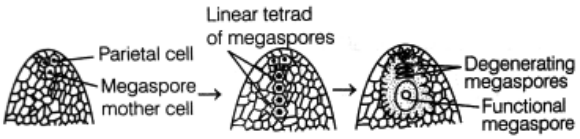
Ans : **SQP 2009, FOREIGN 2010**
Large, shield shaped cotyledon of grass family is called scutellum. Coleorhiza is a sheath protecting the root of germinating grass.
Coleoptile is a sheath covering emerging shoot.
Plumule is rudimentary shoot of an embryo plant.
Thus (c) is correct option.

26. Which of the following statements is not correct?
(a) Insects that consume pollen or nectar without bringing about pollination are called pollen nectar robbers
(b) Pollen germination and pollen tube growth are requlated by chemical components of pollen interacting with those of the pistil
(c) Some reptiles have also been reported as pollinators in some plant species
(d) Pollen grains of many species can germinate on the stigma of a flower, but only one pollen tube of the same species grows into the style

Ans : **COMP 2012, OD 2015**
Pollen grains of different species are incompatible, so they fail to germinate. Only the pollen of the same species germinate and can form pollen tube which grows and finally dispatches male gamete to embryo sac.
Thus (d) is correct option.

27. In majority of angiosperms
(a) egg has a filiform apparatus
(b) there are numerous antipodal cells
(c) reduction division occurs in the megaspore mother cells
(d) a small central cell is present in the embryo sac

Ans : **DELHI 2007**
In most of the angiosperms megaspore mother cell ($2n$) divides meiotically to produce 4 cells. Out of these 3 degenerate and one remains which forms functional megaspore. This divides mitotically and forms embryo sac which contains following structures.



1. One egg cell with 2 synergids forming an egg apparatus.
2. There are 3 antipodal cells.
3. There are two central cells which are seen as secondary nucleus ($2n$).

Egg does not have filiform apparatus. It is the synergids which have special cellular thickenings at the micropylar tip which is called filiform apparatus. This guides pollen tube into the synergids.
Thus (c) is correct option.

28. Pollination in water hyacinth and water lily is brought about by the agency of
(a) water (b) insects or wind
(c) birds (d) bats

Ans : **SQP 2005**
Water hyacinth has single spike of 8-15 conspicuous attractive flowers which attract bees and other insects. These insects pollinate them. This plant is an aquatic weed.
Water lily is also an aquatic plant with large conspicuous coloured flowers. Most of the species are bee pollinated except few species where wind pollination occurs. Insect pollinated flowers have coloured petals, big size and they offer fragrance and nectar to attract insects which bring about pollination in them.
Thus (b) is correct option.

29. The ovule of an angiosperm is technically equivalent to
(a) megasporangium
(b) megaspoophyll
(c) megaspore mother cell
(d) megaspore

Ans : **SQP 2009**
Ovule of an Angiosperm is equivalent to megasporangium which consists of 2 synergids, 1 egg, 3 antipodal cells and a secondary nucleus.
Megaspore mother cell ($2n$) gives rise to ovule. Megasporophylls are sterile structures on which ovule may be present.

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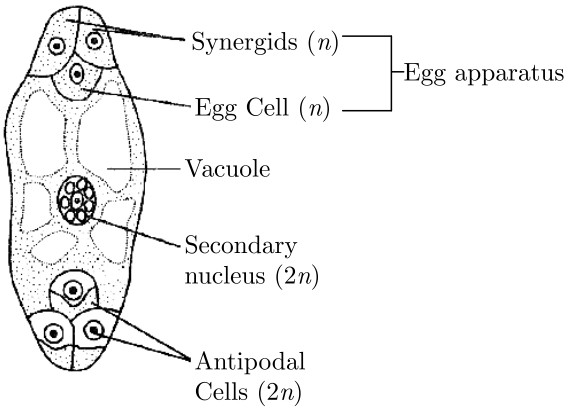

Fig Structure of an ovule

Thus (a) is correct option.

30. Male gametophyte in angiosperms produces
(a) two sperms and a vegetative cell
(b) single sperm and a vegetative cell
(c) single sperm and two vegetative cells
(d) three sperms

Ans : **FOREIGN 2013**
Pollen grain or male gametophyte in angiosperms contain one generative cell. The generative cell further divides meiotically to form two male gametes (sperms). So, a mature male gametophyte in angiosperms contains two sperms and one vegetative cell.
Thus (a) is correct option.

31. The wheat grain has an embryo with one large, shield-shaped cotyledon known as
(a) epiblast (b) coleorhiza
(c) scutellum (d) coleoptile

Ans : **COMP 2018**
The grain of wheat, maize or rice is a caryopsis. The embryo in such grains lies laterally near the base of the grain. The embryo consists of an upper large, shield shaped cotyledon known as scutellum. The scutellum is closely pressed against the endosperm and helps in the translational of nutrients from endosperm to the growing embryo at the time of germination and seedling growth.
Thus (b) is correct option.

32. Which one of the following fruits is Parthenocarpy?
(a) Brinjal (b) Apple
(c) Jack-fruit (d) Banana

Ans : **OD 2023**
Parthenocarpy is a process of developing fruits without involving fertilisation/seed formation. Therefore, the seedless varieties of economically important fruits like orange, banana, watermelon, lemon, etc. are produced using this technique. This technique involves inducing fruit formation by the application of plant growth hormones such as auxins.
Thus (d) is correct option.

33. Filiform apparatus is characteristic feature of
(a) generative cell (b) nucellar embryo
(c) aleurone cell (d) synergids

Ans : **DELHI 2011**
Filiform apparatus are finger-like projections present at the microscopy end of syneragids of embryo sac.
Thus (d) is correct option.

34. In angiosperms, microsporogenesis and megasporogenesis
(a) occur in anther
(b) form gametes without further divisions
(c) involve meiosis
(d) occur in ovule

Ans : **SQP 2012, FOREIGN 2018**
Both event microsporogensis and megasporogenesis involve the process of meiosis which results in the formation of haploid gametes from the microspore or megaspore mother cells.
Thus (c) is correct option.

35. Coconut water from a tender coconut is
(a) immature embryo
(b) free nuclear endosperm
(c) innermost layers of the seed coat
(d) degenerated nucellus

Ans : **DELHI 2005**
The coconut water from tender coconut that we are familiar with, is nothing but free nuclear endosperm (made up of thousands of nuclei) and the surrounding white kernel is the cellular endosperm.
In the most common type of endosperm development, the Primary Endosperm Nucleus (PEN) undergoes successive nuclear divisions to give rise to free nuclei. This stage of endosperm development is called free-nuclear endosperm.
Thus (b) is correct option.

36. Geitonogamy involves
(a) fertilisation of a flower by the pollen from, another flower of the same plant
(b) fertilisation of a flower by the pollen from the same flower
(c) fertilisation of a flower by the pollen from a flower of another plant in the same population

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(d) fertilisation of a flower by the pollen from a flower of another plant belonging to a distant population

Ans : COMP 2009, OD 2013

Geitonogamy is a type of self pollination. In other word geitonogamy is transfer or pollen grain from the anther of one flower to the stigma of another flower of either same or genetically similar plant.
Thus (a) is correct option.

37. Pollen tables are available in the market for
(a) in vitro fertilisation
(b) breeding programmes
(c) supplementing food
(d) ex situ conservation

Ans : FOREIGN 2017

Pollen grains are rich in nutrients. They are taken as tablets and syrups to improve health. Pollen consumption has been claimed to enhance the performance of athletes and race horses.
Thus (c) is correct option.

38. Function of filiform apparatus is to
(a) recognise the suitable pollen at stigma
(b) stimulate division of generative cell
(c) produce nectar
(d) guide the entry of pollen tube

Ans : COMP 2015

Filiform apparatus of synergids secrete some chemotropically active substances, which direct the pollen tube towards micropyle of ovule.
Thus (d) is correct option.

39. Filiform apparatus is a characteristic feature of
(a) egg (b) synergid
(c) zygote (d) suspensor

Ans : FOREIGN 2014

The synergid cell wall forms a highly thickened structure called the filiform appaartus at the micropylar end, consisting of numerous finger-like proections into the syneragid cytoplasm. It is believed to play a major role in pollen tube guidance and reception.
Thus (b) is correct option.

40. Megasporangium is equivalent of
(a) embryo sac (b) fruit
(c) nucellus (d) ovule

Ans : OD 2011

Megasporangium is equivalent to an ovule. An ovule generally has a single embryo sac formed from a megaspore through reduction division. It is a small structure attached to the placenta by means of a stalk called funicle.
Each has one or two protective envelopes called integuments. Nucellus is a mass of cells enclosed with in the integuments. Ovule forms Megaspore Mother Cell (MMC) by meiosis which further forms megaspore.
Megaspore nucleus forms embryo sac. Fruits develop form the ovary of flower, other floral parts degenerate and fall off.
Thus (d) is correct option.

41. Which one of the following statement is correct?
(a) Hard outer layer of pollen is called intine
(b) Sporogenous tissue is haploid
(c) Endothecium produces the microspores
(d) Tapetum nourishes the developing pollen

Ans : DELHI 2010, SQP 2006

Tapetum is the innermost layer of microsporangium. It nouishes the pollen grains. The inner wall of pollen grain is called intine. Endothecium is the wall around the micospoangium, which provide protection and help in dehiscence of anther to release the pollen sporogenous tissue is diploid. It undergoes meiotic division to form microspore tetrads.
Thus (d) is correct option.

42. Advantage of cleistogamy is
(a) higher genetic variability
(b) more vigorous offspring
(c) no dependence on pollinators
(d) viviparous

Ans : SQP 2005

In cleistogamous flowers, anthers and stigma lie close to each other. When anthers dehisces in the flower buds, pollen grains come in contact with the stigma to effect pollination. Thus, these flowers produce assured seed set even in the absence of pollinators.
The higher genetic variability and more vigorous offspring are produced due to variations obtained by sexual reproduction. Viviparous relates to the birth of young babies from mammals.
Thus (c) is correct option.

43. Both, auto-gamy and geitonogamy are prevented in
(a) papaya (b) cucumber
(c) castor (d) maize

Ans : DELHI 2012, SQP 2013, FOREIGN 2020

Auto-gamy involves pollination within the same flower, while geitonogamy involves transfer of pollen grains from the anther of one flower to the

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stigma of another flower of the same plant. Both the processes are prevented in papaya because it is a dioecious plant (i.e. male and female sex organs are born on separate plants) and it always needs cross-pollination.
Thus (a) is correct option.

44. An organic substance that can withstand environmental extremes and cannot be degraded by any enzyme is
(a) cuticle (b) sporopollenin
(c) lignin (d) cellulose

Ans : **COMP 2011, OD 2015, DELHI 2018**
Sporopollenin is a fatty substance present in the exine of pollen grains. It is resistant to microbial and chemical decomposition and can withstand the extreme environmental conditions. Due to the presence of sporopollen, pollen grains are well preserved during fossilisation.
Thus (b) is correct option.

45. Even in absence of pollinating agents seed-setting is assured in
(a) Commelina (b) Zostera
(c) Salvia (d) Fig

Ans : **SQP 2013**
Commelina benghalensis bears aerial, chasmogamous (stigma and anthers exposed to pollinating agents), insect pollinated flowers and underground cleistogamous flowers. Cleistogamous flowers are bisexual flowers which never open, i.e. always remain closed. In such flowers the anthers and stigma lie very close to each other. When anthers dehisce in the flower buds, pollen grains come in contact with the stigma of the same flower, i.e. autogamy occurs. So, these flowers produce assured seed set, even it the absence of pollinators.
Thus (a) is correct option.

46. Wind pollination is common in
(a) lilies (b) grasses
(c) orchids (d) legumes

Ans : **COMP 2010**
Wind pollination (anemophily) is quite common in grasses. Anemophilous flowers are small and inconspicuous with long and versatile stamens. Pollen grains are dry, powdery, light and non-sticky, e.g. maize, wheat, sugarcane, bamboo, Pinus and papaya.
Thus (b) is correct option.

47. Nucellar polyembryony is reported in species of
(a) Gossypium (b) Triticum
(c) Brassica (d) Citrus

Ans : **OD 2007**
Nucellar polyembryony is reported in species of Citrus. Occurrence of more than one embryo in a seed is referred to as polyembryony. In many Citrus and mango varieties, some of the nucellar cells surrounding the embryo sac start dividing, protrude into the embryo sac and develop into the embryos.
Thus (d) is correct option.

48. In which one of the following pollination is autogamous?
(a) Xenogamy (b) Chasmogamy
(c) Cleistogamy (d) Geitonogamy

Ans : **DELHI 2017**
Bisexual flowers which remains always closed are called cleistogamous and such condition of flowers is called cleistogamy. In such flowers, the anthers and stigma lie close to each other. When anthers dehisces in the flowers buds, pollen grains come in contact with stigma to affect pollination. Thus, cleistogamous flowers a invariably autogamous.
Thus (c) is correct option.

49. Apomictic embryos in Citus arise from
(a) synergids
(b) maternal sporophytic tissue in ovule
(c) antipodal cells
(d) diploid egg

Ans : **SQP 2005**
Apomictic embryos in Citrus arise from maternal sporophytic tissue (e.g. nucellus or integuments) in ovule. Apomixis is the formation of new individuals directly through asexual reproduction without involving the formation and fusion of gametes.
Thus (b) is correct option.

50. The scutellum observed in a grain of wheat or maize is comparable to which part of the seed in other monocotyledons?
(a) Cotyledon (b) Endosperm
(c) Aleurone layer (d) Plumule

Ans : **SQP 2007**
In wheat or maize (family-Poaceae), the scutellum is thought to be a modified cotyledon or seed leaf.
Thus (a) is correct option.

51. Wind pollinated flowers are
(a) small, brightly coloured, producing large number of pollen grains
(b) small, producing large number of dry pollen grains
(c) large, producing abundant nectar and pollen
(d) small, producing nectar and dry pollen

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Ans : **FOREIGN 2009**

Pollination taking place by means of wind is known as anemophily, e.g. Zea mays, Cannabis Pinus, etc. Anemophilous flowers are small and produces large number of pollen grains which are dry, powdery light and non-sticky.
Thus (b) is correct option.

52. Unisexuality of flowers prevents
(a) autogamy, but not geitonogamy
(b) both geitonogamy and xenogamy
(c) geitonogamy, but not xenogamy
(d) autogamy and geitonogamy

Ans : **OD 2012**

Unisexuality of flowers prevents autogamy, but not geitonogamy. Autogamy also called self-pollination involves the transfer of pollen grains of one flower to the stigma of same flower. Self-pollination occurs only in bisexual or hermaphrodite flowers. Geitonogamy involves the transfer of pollen grains from a male flower to stigma of female flower of same plant. Thus, geitonogamy operates only in monoecious plants, i.e. plants having male and female flowers on different places.
Autogamy or xenogamy also known as cross-pollination involves the transfer of pollen grains of male flower to the stigma of genetically different female flower. It takes place via various agencies like wind, water, insects, etc.
Thus (a) is correct option.

53. Which one of the following pairs of plant structures has haploid number of chromosomes?
(a) Megaspore mother cell and antipodal cells
(b) Egg cell and antipodal cells
(c) Nucellus and antipodal cells
(d) Egg nucellus and secondary nucleus

Ans : **DELHI 2012, SQP 2013, FOREIGN 2015, COMP 2016**

Egg cell and antipodal cells have haploid number of chromosomes. In angiosperms a single diploid megaspore mother cell matures within an ovule. Through meiosis it gives rise to four megaspore (haploid). In most plants only one of these megaspore survive. This functional megaspore divides three times by mitosis and produces eight haploid nuclei enclosed within a 7-celled embryo sac. One nucleus is located near the opening of embryo sac in egg cell.
Two nuclei are located in a single cell in the middle of embryo sac and are called polar nuclei, two nuclei are contained in cells called synergids that flank the egg cell and other three nuclei are resided in the cells called antipodals, located at the end of embryo sac opposite the egg cell.
Thus (b) is correct option.

54. Endosperm is consumed by developing embryo in the seed of
(a) coconut (b) castor
(c) pea (d) maize

Ans : **OD 2017**

Endosperm is consumed by developing embryo is the seeds of pea (Pisum sativum). These seed are called non-endospermic seeds. Other examples are gram, beans, orchids, etc.
Thus (c) is correct option.

55. Male gametes in angiosperms are formed by the division of
(a) microspore
(b) generative cell
(c) vegetative cell
(d) microspore mother cell

Ans : **DELHI 2019**

Male gametes n angiosperms are formed by the division of generative cell. Before pollination the pollen grain cytoplasm divides in generative cell and vegetative cell. The generative cell divides to form two male gametes.
Thus (b) is correct option.

56. Which one of the following is resistant to enzyme action?
(a) Cork (b) Wood fibre
(c) Pollen exine (d) Leaf cuticle

Ans : **COMP 2016**

Pollen exine is resistant to enzyme action. The pollen wall is consisted of two layers, the outer exine and inner intine. The exine is chiefly made up of sporopollenin, which is derived by the oxidative polymerisation of carotenoids. Sporopollenin is one of the most resistant biological materials known. Exine is thin in beginning but become very thick with maturity.
Thus (c) is correct option.

57. Which one of the following is surrounded by a callose wall?
(a) Microspore mother cell (b) Male gamete
(c) Egg (d) Pollen grain

Ans : **SQP 2020**

The wall of the pollen mother cell (microspore mother cell) is deposited by callose (β-1, 3-glucan). Callose plays a significant role in reproductive biology of angiosperms. It acts as a temporary wall to prevent the product of meiosis from cohesion and fusion and its dissolution results in the release of free spores.
Thus (a) is correct option.

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58. The arrangement of the nuclei in a normal embryo sac in the dicot plants is

(a) $3+2+3$ (b) $2+3+3$

(c) $3+3+2$ (d) $2+4+2$

Ans : **FOREIGN 2021**

In angiosperms (dicots), the Polygonum type of embryo sac is most common. In this embryo sac, the arrangement of the nuclei is $3+2+3$, i.e. 3 in antipodal cells, 2 as polar nuclei (which later fuse and form a diploid secondary nucleus) and 3 in egg apparatus (2 in synergids and 1 in egg cell). Thus (a) is correct option.

59. What would be the number of chromosomes in the cells of the aleuron layer in a plant species with 8 chromosomes in its synergids?

(a) 24 (b) 32

(c) 8 (d) 16

Ans : **COMP 2022**

Synergids are two, short-lived, haploid cells lying close to the egg in mature embryo sac of flowering plant ovule. While the endosperm is a tripled tissue formed after triple fusion. Thus, if the synergids have 8 chromosomes, the aleuron layer (part of endosperm) will have just triple of that of chromosomes in the synergids, i.e. 24 chromosomes.
Thus (a) is correct option.

60. Which one of the following represents an ovule, where the embryo sac becomes horse shoe-shaped and the funiculars and microscopy are close to each other?

(a) Amphitropous (b) Circinotropous

(c) Atrocious (d) Anatropous

Ans : **OD 2013**

In an amphitropous ovule, the embryo sac becomes horse-shoe shaped and the funiculars and micropylar are close to each other. This type of ovule is found in Alismaceae, Butomaceae families.

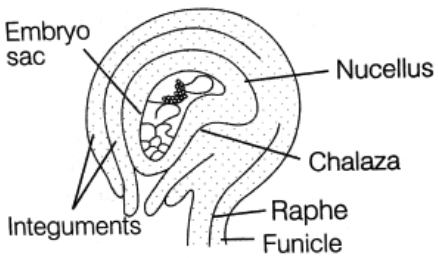

Fig Amphitropous ovule

Thus (a) is correct option.

61. In a type of apomixis known as adventively embryony, embryos develop directly from the

(a) nucellus or integuments

(b) zygote

(c) synergids or antipodals in an embryo sac

(d) accessory embryo sac in the ovule

Ans : **OD 2005**

Apomixis does not involve gamete formation and fertilisation as found in amphimixis. Adventively embryo formation is a type of apomixis in which embryos are formed from diploid integumental or nucellus cells.
Thus (a) is correct option.

62. Through which cell of the embryo sac, does the pollen tube enter the embryo sac

(a) egg cell

(b) persistant synergids

(c) degenerated synergids

(d) central cell

Ans : **DELHI 2009, SQP 2008**

Egg apparatus is present towards the micropylar end of an ovule. Egg apparatus has two lateral synergids cells and one centrally located egg cell. During entry of pollen tube within the ovule synergids cells become disintegrate and provide path for entry of pollen tube within the chamber of embryo sac.
Thus (c) is correct option.

63. In angiosperms pollen tubes liberate their male gametes into the

(a) centre cell (b) antipodal cell

(c) egg cell (d) synergids

Ans : **SQP 2016**

The contents of the pollen tube are discharged in the synergids from where the first male gamete is transferred to the egg cell, while the other male gamete moves to the central cell through cytoplasmic current.
Thus (d) is correct option.

64. An ovule which becomes curved so that the nucellus and embryo sac lie at right angles to the funicle is

(a) hemitropous (b) campylotropous

(c) anatropous (d) orthotropous

Ans : **FOREIGN 2012, COMP 2011**

In hemitrupous type, the ovule becomes curved and nucellus and embryo sac lie at right angles to the funicle, e.g. Ranunculaceae and Primulaceae.

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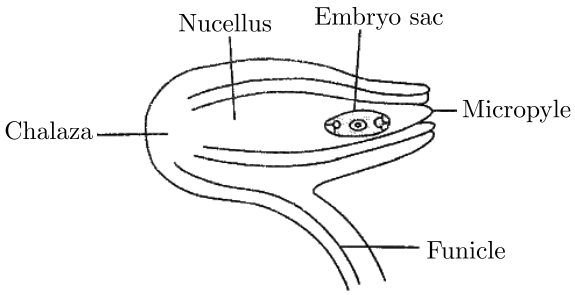

Thus (a) is correct option.

65. In a flowering plant, archesporium gives rise to
(a) only tape-tum and sporogenous cells
(b) only the wall of the sporangium
(c) both wall and the sporogenous cells
(d) wall and the tape-tum

Ans : OD 2010

The archesporial cells divide periclinally, cutting off primary parietal layer (forming wall later on) towards the outer side and primary sporogenous cells towards the inner side. The cells of the primary parietal layes divide by successive periclinal and anticlinal division to form concentric layers of pollen sac wall.
Thus (c) is correct option.

66. Which type of association is found in between entomophilous flower and pollinating agent?
(a) Mutualism (b) Commercialism
(c) Cooperation (d) Co-evolution

Ans : DELHI 2012

A plant and its pollinator have a mutualistic relationship. The plant uses its pollinator to ensure cross-pollination while pollinator uses the plant as food.
Thus (a) is correct option.

67. What is the direction of micropylar in anatropous ovule?
(a) Upward (b) Downward
(c) Right (d) Left

Ans : FOREIGN 2017

Body of the anaptropus ovule gets inverted and micropyle is on lower side (downward). Further micropyle and funiculars lie side by side and micropyle is close to hilum.
Thus (b) is correct option.

68. In angiosperms all the four microspores of tetrad are covered by a layer which is formed by
(a) pectocellulose (b) callose
(c) cellulose (d) sporopollenin

Ans : COMP 2019

The deposition of callose starts in pollen mother cell as it enters meiosis and is complete by the end of first meiotic division. By the time tetrad are formed, the common callose wall dissolves, even then all the four microspores lie within a common callose wall.
Thus (b) is correct option.

69. Adventively embryony in Citrus is due to
(a) nucellus (b) integuments
(c) zygotic embryo (d) fertilised egg

Ans : SQP 2005

Nucellus embryony occurs in crassinucellate ovules (e.g. Citrus, Opuntia). On the other hand integumentary embryony occurs in tenuniucellate ovules (e.g. Euonymus).
Thus (a) is correct option.

70. Anemophily type of pollination is found in
(a) Salvia (b) bottle brush
(c) Vallisneria (d) coconut

Ans : OD 2005

Pollination through air is known as anemophily e.g. coconut.
In Salvia, the pollination is taken place by insects (entomophily).In Vallisneria, the pollination occurs through water (hydrophily).
In bottle brush (Callistemon) the pollination occurs through birds (ornithophily).
Thus (d) is correct option.

71. Eight nucleate embryo sacs are
(a) always tetrasporic
(b) always monosporic
(c) always bisporic
(d) sometimes monosporic, sometimes bisporic and sometimes tetrasporic

Ans : DELHI 2006

Megaspore is a haploid structure which divides and gives rise to embryo sac which is also called as female gametophyte.
Eight-nucleate embryo sacs may be monosporic (e.g. Polygonum) or bisporic (e.g. Allium) or tetrasporic (e.g. Adoxa).
Thus (d) is correct option.

72. Double fertilisation leading to initiation of endosperm in angiosperms require
(a) fusion of one polar nucleus and the second male gamete only
(b) fusion of two polar nuclei and the second male gamete.

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(c) fusion of four or more polar nuclei and the second male gamete only

(d) all of the above kinds of fusion in different angiosperms

Ans : OD 2005

In angiosperms the endosperm is a special tissue which is formed as a result of triple fusion. In triple fusion the second male gamete fuses with secondary nucleus (diploid nucleus formed by fusion of two polar nuclei) to form tripled primary endosperm nucleus.
Thus (b) is correct option.

73. Flowers showing ornithophily show few characteristic like

(a) blue flower with nectaries at base of corolla.

(b) red sweet scented flower with nectaries.

(c) bright red flower into thick inflorescence.

(d) white flowers with fragrance.

Ans : SQP 2011

Ornithophily is an allogamy performed by birds, such as long beaked small birds (sun birds, humming birds), crow, parrot, bulbul, etc. Ornithophoilous flowers are large and showy cup-shaped with abundant nectar or edible part, e.g. Bombay, Agave, etc.
Thus (b) is correct option.

74. How many pollen grains will be formed after meiotic division in 10 microspores mother cells?

(a) 10 (b) 20

(c) 40 (d) 80

Ans : FOREIGN 2013

One microspores mother cell form four pollen grains after meiotic division, so, 10 microspores mother cells will form 40 pollen grains through dividing meiotically.
Thus (c) is correct option.

75. In angiosperms, triple fusion is required for the formation of

(a) embryo (b) endosperm

(c) seed coat (d) fruit wall

Ans : COMP 2007

In angiosperms, triple fusion is required for the formation of endosperm. Triple fusion refers to the vegetative fertilisation, i.e. the fusion of nucleus of a male gamete with the two polar nuclei or the diploid secondary (fusion) nucleus. Triple fusion converts central cell into triploidy primary endosperm cell which forms the endosperm, a nutritive tissue.
Thus (b) is correct option.

76. In an angiosperm, how many microspore mother cells are required to produce 100 pollen grains?

(a) 25 (b) 50

(c) 75 (d) 100

Ans : OD 2011

In angiosperms, each **Microspore Mother Cell** (MMC) undergoes meiosis to produce four microspores which develop into pollen grains. Thus to produce 100 pollen grains, 25 micropore mother cells are required.
Thus (a) is correct option.

77. Fertilisation involving carrying of male gametes by pollen tube is

(a) porogamy (b) siphonogamy

(c) chalazogamy (d) syngonogamy

Ans : DELHI 2017

In angiosperms, the male gametes are carried by the pollen tube and such type of fertilisation or fusion of male and female gametes or syngamy is called **siphonogamy**. It was discovered by **Strasburger** (1884).
Thus (b) is correct option.

78. Chief pollinators of agricultural crops are

(a) butterflies (b) bees

(c) moths (d) beetles

Ans : SQP 2018

Bees are considered the most common pollinators which pollinate about 80% of the total insect pollinated flowers.
Thus (b) is correct option.

79. Ovule is straight with funiculus, embryo sac, chalaza and micropyle lying on one straight line. It is

(a) orthotropous (b) anatropous

(c) campylotopous (d) amphitropous

Ans : FOREIGN 2017

Orthotropous or atropous is the erect ovule in which the body of ovule lies straight and upright over the funicle. Hilum, chalaza and micropyle occur on one straight line, e.g. family-Polygonaceae and Piperaceae.
Thus (a) is correct option.

80. Double fertilisation and triple fusion were discovered by

(a) Hofmeister

(b) Nawaschin and Guignard

(c) Leeuwenhoek

(d) Strasburger

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Ans :

Double fertilisation was discovered by Nawaschin (1898) in Fritilaria and Lilium. It wat confirmed by Guignard (1899). Syngamy (one male gamete fuse with egg cell to form zygote) and triple fusion (second male gamete fuses nucleus to with two polar nuclei or secondary nucleus to from triploidy primary endosperm nucleus occurs simultaneously in angiosperms and this is called double fertilisation).
Thus (b) is correct option.

81. Study of formation, growth and development of new individual from an egg is
(a) apomixis (b) embryology
(c) embryogeny (d) cytology

Ans : **OD 2009**

Embryology (Gr. en-in; bryo-swell; logos-study) is the study of formation growth and development of embryo. It includes sporogenesis, fertilisation and embryogeny, i.e. the overall process starting from formation of gametes, fertilisation, zygote and embryo formation and development of new individual.
Thus (b) is correct option.

82. Meiosis is best observed in dividing
(a) cells of apical meristem
(b) cells of lateral meristem
(c) microspores and anther wall
(d) microsporocytes

Ans : **DELHI 2010, SQP 2015**

Microsporocytes or microspore mother cells are diploid cells formed from sporgenous cells in the anther. The pollen/microspore mother cells undergo meiosis and form tetrads of microspores or pollen grains. The wall of pollen mother cell degenerates and pollen or microspores separate.
Thus (d) is correct option.

83. Double fertilisation is fusion of
(a) two eggs
(b) two eggs and polar nuclei with pollen nuclei
(c) one male gamete with egg and other with synergid
(d) one male gamete with egg and other with secondary nucleus

Ans : **FOREIGN 2012, COMP 2017**

Double fertilisation deals with the fusion of one male gamete with egg to form zygote and the other male gamete with secondary nucleus to form Primary Endosperm Nucleus (PEN).
Thus (d) is correct option.

84. Point out the odd one
(a) nucellus (b) embryo sac
(c) micropyle (d) pollen grain

Ans : **OD 2009**

Nucellus is the parenchymatous nutritive tissue of ovule, micropyle is the pore present in the integuments at one end of ovule and embryo sac represents the female gametophyte. Thus, nucellus, micropyly and embryo sac are part of ovule, whereas, pollen grain/microspore represents the immature male gametophyte.
Thus (d) is correct option.

85. Embryo sac occurs in
(a) embryo
(b) axis part of embryo
(c) ovule
(d) endosperm

Ans : **DELHI 2007**

Embryo bsac occurs in ovule. Megaspore mother cell is developed inside the nucellus of the ovule and by a meiotic division it forms four megaspores, out of which three degenearte. The functional megaspore divides mitotically to form embryo sac.
Thus (c) is correct option.

86. Pollination occurs in
(a) bryophytes and angiosperms
(b) pteridophytes and angiosperms
(c) angiosperms and gymnosperms
(d) angiosperms and fungi

Ans : **SQP 2011**

Pollination is the transfer of pollen grains from anther to stigma of same or different flower. It is a characteristic features of higher plants i.e. angiosperm and but also found in few gymnosperms.
Thus (c) is correct option.

87. Female gametophyte of angiosperms is represented by
(a) ovule
(b) megaspore mother cell
(c) embryo sac
(d) nucellus

Ans : **COMP 2005**

In angiosperms, female gametophyte is represented by embryo sac. Embryo sac is produced by the functional megaspore formed through meiosis of megaspore mother cell in ovule. The common type of embryo sac is monosporic Polygonum type, it

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is 7-celled and 8-nucleate structure covered by a thin membrane formed of megaspore wall.
Thus (c) is correct option.

88. Entry of pollen tube through micropyle is
(a) chalazogamy (b) mesogamy
(c) porogamy (d) pseudogamy

Ans : FOREIGN 2015

Porogamy ferers to the most common method by which the pollen tube enters the ovule through micropyle, e.g. lily. When pollen tube enters through chalaza, it is known as chalazogamy and when it enters laterally through integumets, then such process is known as mesogamy.
Thus (c) is correct option.

89. Male gametophyte of angiosperms/monocots is
(a) microsporangium (b) nucellus
(c) microspore (d) stamen

Ans : COMP 2018

Microspore or pollen grain is an immature male gametophyte and thus, represents the first cell of gametophytic generation in angiosperms. Microspores are generally rounded, small uninucleate haploid cells produced as a result of meiosis in microspore mother cell inside the microsporangia. The process of formation of microspore inside the pollen sacs of anthers is known as microsporogenesis.
Thus (c) is correct option.

90. Generative cell was destroyed by laser but a normal pollen tube was still formed because
(a) vegetative cell is not damaged
(b) contents of killed generative cell stimulate pollen growth
(c) laser beam stimulates growth of pollen tube
(d) the region of emergence of pollen tube is not harmed

Ans : Delhi 2005

Pollen grain or microspore divides mitotically forming a larger tube or vegetative cell and a small generative cell. Since, vegetative cell gives rise to pollen tube and generative cell divides to form two male gametes, thus if a generative cell is destroyed by laser, a normal pollen tube will still form through the vegetative cell which is undestroyed.
Thus (a) is correct option.

91. Nucellus embryo is
(a) amphimictic haploid
(b) amphimictic diploid
(c) apomictic haploid
(d) apomictic diploid

Ans : OD 2019

Nucellus embryo is apomictic haploid. Nucellus is a parenchymatous, haploid nutritive tissue of the ovule of phanerogams. The phenomenon of formation of embryo or new individual directly through asexual reproduction or adventitiously from a cell other than egg, i.e. nucellus, integuments, etc., is known as **apomixis**. Nucellus embryo is thus, known as **apomictic embryo**.
Thus (c) is correct option.

92. Formation of gametophyte directly from sporophyte without meiosis is
(a) apospory (b) apogamy
(c) parthenogenesis (d) amphimixis

Ans : DELHI 2020

Apospory is the formation of gametophyte directly from sporophyte without forming spores and meiosis. The gametophytes formed through apospory are usually diploid. Apospory leads to polyploidy and hence, new species in bryophytes and pteridophytes.
Thus (a) is correct option.

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93. Total number of meiotic divisions required for forming 100 zygotes/100 grains of wheat are
(a) 100 (b) 75
(c) 125 (d) 50

Ans :

Total number of meiotic divisions required for forming 100 zygote/100 grains of wheat are 125. Zygote is the fusion product of pollen grains and egg. 100 zygotes require 100 pollen grains and 100 embryo sacs. 100 pollen grains are produced from 25 microspore mother cells while 100 embryo sacs are formed from 100 functional megaspore which as a result being produced by 100 megaspore mother cells, since three, out of four megaspore degenerate in each case.
Thus (c) is correct option.

94. Male gametophyte of angiosperms is shed as
(a) four-celled pollen grain
(b) three-celled pollen grain
(c) microspore mother cell
(d) anther

Ans : OD 2005

In angiosperms, pollen grains are generally shed from the anther at 2-celled stage, i.e. one generative cell and one vegetative cell. But, in some angiosperms, the generative cell divides

prior to the dehiscence of anther and shed at 3-celled stage, i.e. one vegetative cell and two male gametes. Double fertilisation was discovered by Nawaschin (1898) in Fritillaria and Lilium. It was confirmed by Guignard (1899).
Thus (b) is correct option.

95. Number of meiotic divisions required to produce 200/400 seeds of pea would be
(a) 200/400 (b) 400/800
(c) 300/600 (d) 250/500

Ans : **COMP 2007**

200 seeds of pea would be produced from 200 pollen grains and 200 embryo sacs. 200 pollen grains will be formed by 50 microspore mother cells, while 200 embryo sacs will be formed by 200 megaspore mother cells. Similarly 400 seeds of pea would be produced from 400 pollen grains and 400 embryo sacs. 400 pollen grains will be formed by 100 Microspore Mother Cell (MMC) and 400 embryo sacs fromed by 400 Megaspore Mother Cell (MMC). Thus, number of meiotic divisions required to produce 200/400 seeds would be 250/500.
Thus (d) is correct option.

ASSERTION AND REASON

DIRECTION : Each of these questions contains as Assertion following by Reason. Read them carefully and answer the question on the basis of following options. You have to select the one that best describes the two statements.

96. **Assertion :** If pollen mother cells has 42 chromosomes, the pollen has only 21 chromosomes.
Reason : Pollens are formed after meiosis in pollen mother cell.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans :

Pollen mother cells undergo meiosis and produce pollen grains. The pollen grains have haploid number of chromosomes.
Thus (a) is correct option.

97. **Assertion :** Insects visit flower to gather honey.
Reason : Attraction of flowers prevents the insects from damaging other parts of the plant.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans :

Honey bee visit flowers to gather nectar and turn it into honey. Visiting of insects for nectar helps in pollination.
Thus (d) is correct option.

98. **Assertion :** Pollen mother cells (PMCs) are the first male gametophytic cells.
Reason : Each PMC gives rise to two pollens.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : .

Primary sporogenous cell gives rise to microspore mother cells or pollen mother cells (PMCs). They are sporophytic in nature i.e., diploid. These cells undergo meiosis (reduction division) which gives rise to 4 microspores of pollens and this formation of microspores or pollens is called microsporogenesis. Microspores represent the beginning of the gametophytic phase and they are haploid in nature.
Thus (d) is correct option.

99. **Assertion :** Chasmogamous flowers require pollinating agents.
Reason : Cleistogamous flowers do not expose their sex organs.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

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Ans :
The majority of angiosperms bear chasmogamous flowers, which means the flowers expose their mature anthers and stigma to the pollinating agents. There is another group of plants which set seeds without exposing their sex organs. Such flowers are called cleistogamous and the phenomenon is cleistogamy.
Thus (b) is correct option.

100. **Assertion :** Double fertilization is characteristic feature of angiospersms.
Reason : Double fertilization involves two fusions.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans :
Double fertilization is a characteristic feature of angiosperms. It involves two fusions in which one female gametes fuse with egg cell to form zygote and other male gamete fuses with the diploid secondary nucleus to produce triploid primary endosperm nucleus.
Thus (b) is correct option.

101. **Assertion :** Endosperm is a nutritive tissue and it is triploid.
Reason : Endosperm is formed by fusion of secondary nucleus to second male gamete. It is used by developing embryo.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans :
Male gamete $(n)+$ secondary nucleus $(2n)$ = primary endosperm nucleus which develops into endosperm $(3n)$ Endosperm is the reserve food used by developing embryo.
Thus (a) is correct option.

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VERY SHORT ANSWER QUESTIONS

102. An anther with malfunctioning tapetum often fails to produce viable male gametophytes. Give any one reason.
Ans : **DELHI 2013**
An anther with malfunctioning tapetum often fails to produce viable male gametophytes due to lack of nutrients.

103. Give an example of a plant which came into India as a contaminant and is a cause of pollen allergy.
Ans : **OD 2014**
Pollen grains of Parthenium came into India as a alignment contaminant and is a cause of pollen allergy.

104. Which is triploid tissue in a fertilised ovule?
Ans : **SQP 2012**
Primary Endosperm Cell (PEE) is the triploid cell which gives rise to endosperm, a triploid tissue in a fertilised ovule.

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105. Why do we call embryo sac monosporic?
Ans : **OD 2019**
An embryo sac is called monosporic because it develops from one of the four megaspores formed from the division of megaspore mother cell.

106. Name the largest cell of the embryo sac.
Ans : **FOREIGN 2011**
Central cell is the largest cell of the embryo sac.

107. Mention the reason of difference in ploidy of zygote.
Ans : **COMP 2009**
Zygote (2n) is formed by the fusion of one male gamete (n) and an egg cell (n). Therefore, its ploidy level is different from the other cells of the embryo sac.

108. Name the homologous structures of embryos of a typical dicot embryo and a grass embryo.
Ans : **OD 2007**
Cotyledons of a typical dicot embryo and scutellum of a grass embryo are homologous structures.

109. Name two plants where remnants of nucellus can be found in seeds.
Ans : **DELHI 2012**
In black pepper and beet, remnants of nucellus are found in seeds.

110. What is seed dormancy? What is its significance?
Ans : **SQP 2018**
The state of temporary inactivity of embryo is

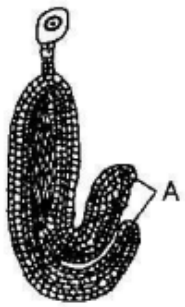
known as seed dormancy. It helps the seeds to survive in unfavourable conditions and germinate in suitable conditions.

111. Name the part of the flower which the tassels of corn cob represent.

Ans : **OD 2014**

Tassels are stigma and style (parts of gynoecium) of corn flowers.

112. Identify A in the figure showing a stage of embryo development in a dicot plant and mention its function.



Ans : **All India 2016**

A is cotyledon. It is the storehouse of food.

113. Give the name of the common functions that cotyledons and nucellus perform.

Ans : **COMP 2019**

The common functions of cotyledons and nucellus are

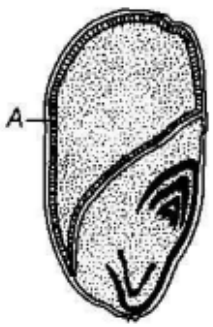
1. storage of reserve food material.
2. nourishment of embryo and embryo sac, respectively

114. Mention any one significance of fruit formation.

Ans : **FOREIGN 2005**

Fruits protect the seed from mechanical injury.

115. Given below is a section of maize grain. Identify A and state its function.



Ans : **OD 2016**

A is endosperm. It provides nutrition to the developing embryo

116. Name the parts of pistil which develop into fruits and seeds.

Ans : **DELHI 2011**

The parts of pistil which develop into fruits and seed are ovary and ovules, respectively.

117. Why is apple called a false fruit? Which part(s) of the flower forms the fruit?

Ans : **SQP 2010**

Apple is called a false fruit because it develops from the thalamus instead of ovary (thalamus is the enlarged structure at the base of the flower).

118. Which layer of microsporangial wall helps in the formation of sporopollenin?

Ans :

Tapetal cells of microsporangial wall help in the formation of sporopollenin.

119. What is the position of plumule in monocot embryo?

Ans : **COMP 2006**

Lateral

120. Write down the ploidy of the cell of microspore tetrad.

Ans : **OD 2020**

Cells of microspore tetrad are formed by meiosis. Therefore, they are haploid (n) in nature.

121. Give the name of any two non-albuminuous seeds.

Ans : **DELHI 2013**

Pea and groundnut.

122. Name the seeds that have retained their viability for thousands of years.

Ans : **SQP 2014**

Lupinus arcticus (lupine; 10000 years) and Phoenix dactylifera (date palm; 2000 years).

SHORT ANSWER QUESTIONS

123. Define and give one example of each of the following:

1. True fruit
2. Parthenogenic fruits
3. Polyembryony

Ans : **OD 2018**

1. **True fruit**– A true fruit develops from a ripened ovary. Such fruits have regions outer epicarp, middle mesocarp and innermost endocarp. e.g. mango, tomato etc.

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2. **Parthenogenic fruits**– These fruits develops from unfertilised flower eg. Banana, grapes etc.
3. **Polyembryony**– The production of two or more embryos in one seed, either due to existence and fertilisation of more than one embryonic sac or due to origination of embryos outside of the embryonic sac, is termed as polyembryony. e.g. citrus plants.

124. Define Ovule.

Ans : **FOREIGN 2005**

An ovule is an integumented megasporangium within which the meiosis and megaspore formation takes place. Ovule develops into a seed after fertilization. A mature ovule contains nucellus, integuments and funiculus through which it adheres to the placenta. Integuments cover an opening called micropyle, which is the site of entry of pollen tube during fertilisation. The region opposite to micropylar pole is called chalaza.

125. What do you understand by polyembryony ?

Ans : **OD 2014**

Polyembryony is a condition in which two or more embryos develop from a single fertilized egg. Such embryos are identical to one another but genetically different from the parents. It is found in both plants as well as animals. It was first observed by Leeuwenhoek in citrus (orange) plant. It can be natural, spontaneous or can be artificially induced.

In case of humans, polyembryony results in identical twins.

126. Write about false fruit with examples.

Ans : **OD 2013**

A false fruit or pseudocarp is a fruit derived from the floral parts other than ovary such as peduncle in cashew-nut, thalamus in apple, pear, gourd and cucumber; fused perianth in mulbery and calyx in Dillenia. False fruits are also called spurious or accessory fruits.

127. Define Monocarpic fruits with examples.

Ans : **OD 2013**

Monocarpic plants flower only once in their life. These plants are generally annual or biennial. Very few monocarpic fruits are perennial. Monocarpic plants dies after flowering and fruiting. Examples; Rice, Wheat, Radish, Carrot, Bamboo, etc.

128. What do you mean by protandry? Write its benefits.

Ans : **OD 2013**

The condition in which the male reproductive organs (Stamens) of a flower mature before the female ones (carples), thereby ensuring that self-fertilization does not occur. Examples of protandrous flowers are ivy and rosebay will willowherb. E.g. marigold, maize, cotton etc.

129. Write adaptations in wind pollinated flowers.

Ans : **SQP 2005**

The main adaptation of wind pollinated plants are :

1. The flowers are small and in conspicuous, lacks fragrance and nectar.
2. They are not with attractive colours.
3. The perianth lobes are reduced.
4. The pollen grains are smooth, light and dry.
5. Usually bears unisexual flowers.
6. The male flowers possess long filament so as to expose the anther to wind.
7. Anthers are versatile so that it swings in air.
8. The female flowers are large possess entire stigmatic surface receptive.

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130. Write two major functions each of testis and ovary.

Ans : **OD 2005**

The testicles are the primary male reproductive organs. They have two, very important functions in the male reproductive system: they produce gametes,or sperm, and they secrete hormones, primarily testosterone. Testrosterone control how the male reproductive system grows, and the development of "masculine" body features such as beards and a deep voice. They also influence sexual functions.

The ovaries are the primary female reproductive organs. The ovaries have two main reproductive functions in the body. They produce oocytes (eggs) for fertillisation and they produce the reproductive hormones, oestrogen and progesterone. The function of the ovaries is controlled by gonadotrophin-releasing hormone released from nerve cells in the hypothalamus which send their messages to the pituitary gland to produce luteinising hormone and follicle simulating hormone.

131. Differentiate between micro-sporongenesis and megasporogenesis. Which type of cell division occurs during these events? Name the structures formed at the end of these two events.

Ans : **SQP 2010**

Difference between Micro-sporogenesis and Megasporogenesis ara as follows :

	Microsporogenesis		**Megasporogenesis**
1.	It is the process of formation of microspores from a pollen mother cell by meiosis.	1.	It is the process of formation of the megaspores from the megaspore mother cell.
2.	The microspore formed are arranged in a microspore tetrad.	2.	The embryo sac is formed inside the ovule/ megasporangium. It develops form a single megaspore.
3.	Microspore develops into pollen grains.	3.	Megaspore forms female gametophyte.
4.	Microsporogenesis occurs in the cells of anther called sporogenous cells.	4.	Megasporogenesis ocures in the megaspore mother cell in nucellar region.

1. **Microsporogenesis:** The sporogenous cells, in developing anther undergo **meiotic division**. From MMC microspores are formed by **meiosis**. **Pollen grains** are formed.
2. **Megasporogenesis:** MMC undergoes **meiosis**. Megaspore develops into **embryo sac**. Nucleus of functional megaspore divides **mitotically** to form 2 nucleate embryo sac. Mitotic divisions make it 8 nucleate. The **mitotic divisions** are **free nuclear**.

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132. With a neat labelled diagram, describe the parts of a typical angiosperm ovule.

Ans : **SQP 2015**

The ovule is called megasporangium. It is a small structure attached to placenta by a stalk named **funicle**. At **hilum**, the body of ovule is fused to funicle. Each ovule possesses one or two integuments which enclose ovule except the micropyle. **Chalaza** is the basal part of an ovule. The nucleus encloses a mass of cells. Embryo sac is 7 celled but 8 nucleate lies in the ovule. It is called female gametophyte.

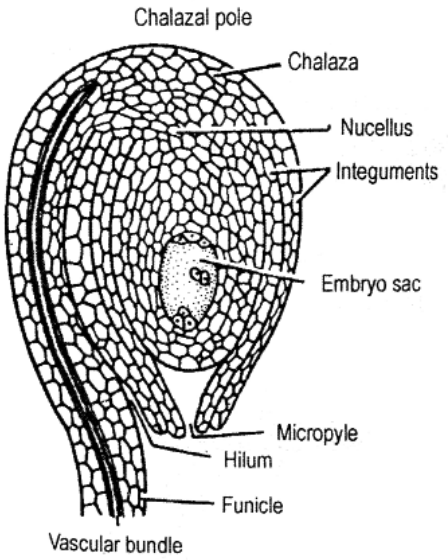

Fig Longitudinal section of an anatropous ovule with the two integuments and micropyle.

133. What do you mean by monosporic development of female gametophyte ?

Ans : **COMP 2013**

The **functional megaspore** divides thrice mitotically to form eight nuclei. This enlarged megaspore is called **embryo sac** or **female gametophyte**. These eight nuclei of embryo sac undergo rearrangement with three nuclei at micropylar end, three at chalazal end and two in the centre, called **polar nuclei**. Three nuclei at micropylar end organise into two **synergids** and one **egg-cell**. Three nuclei at chalzal ends form **antipodal cells**. The two **polar nuclei** fuse to form **diploid secondary nucleus** (definitive nucleus).

Thus, the female **gametophyte in angiosperms** is called **embryo sac** which is formed in the ovule or megasporagium. The mature embryo sac has **seven cells** in all.

P. Maheswari (1950) explained three types of female gametophytes:

1. Monosporic, 2. Bisporic and 3. Tetra sporic.

This division is based upon the number of megaspore nuclei which take part in development. The development described above is of **monosporic type**. It is known as **polygonum type**.

134. With a neat labelled diagram, explain the 7 celled, 8 nucleate nature of the female gametophyte.

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Ans : FOREIGN 2015

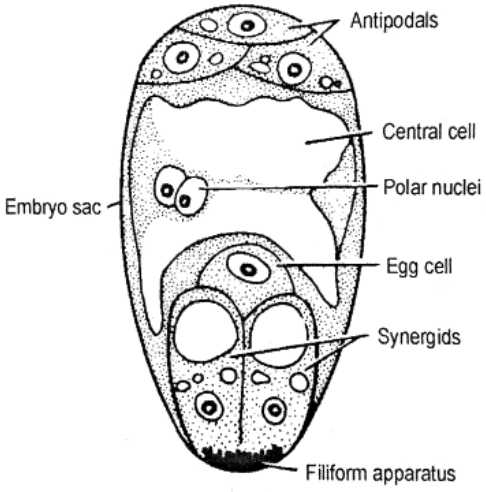

Fig The embryo sac contains an egg, two synergids, three antipodal cells and two polar nuclei.

Mature Female Gametophyte: At 8 nucleate stage of embryo sac, the cell walls are laid down. Six of 8 nuclei are surrounded by cell walls and organized into the cells. The remaining 2 nuclei in the centre of emrbyo sac are **polar nuclei**. They lie below egg apparatus in the big central cell. Three cells at micropylar end form egg apparatus. It has **2 synergids** and one **egg cell**. Three other cells at chalzal end form **antipodals**. The big central cell has 2 nuclei. So mature 8 nucleate embryo sac is 7 celled.

135. What are chasmogamous flowers? Can cross-pollination occur in cleistogamous flowers? Give reasons for your answer.

Ans : OD 2008

Chasmogamous Flowers: These have anthers and stigma very similar to other flowers. The cleistogamous flowers do not open at all. These are **autogamous** flowers and in these **cross pollination** does not occur. In them the anther dehisces in flowers buds and pollens come in contact with stigma there.

136. Mention two stragegies evolved to prevent self-pollination in flowers.

Ans : SQP 2010

Contrivances of self pollination:

1. **Hermaphroditism (Bisexuality):** Self-pollination occurs only in **bisexual flowers** or the complete flowers.
2. **Homogamy:** Both sex organs of a plant must mature at the same time e.g., potato and sunflower.
3. **Cleistogamy:** Cleistogamous flowers do not open and are bisexual and small e.g., Oxalis, Arachis, Viola (common pansy). The anthers mature as well as burst to release pollen grains.

137. What is self incompatibility? Why does self-pollination not lead to seed formation in self-incompatible species?

Ans : FOREIGN 2009

Incompatibility: It is defined as "the inadility of certain gametes even from genetically similar plant species to fuse with each other." It is also known as **intraspecific incompatibility**, or **self-sterility or self-incompatibility**. It occurs due to prevention of some physiological or morphological mechanisms. It involves many complex mechanisms related with interactions of **pollen** and **stigmatic tissues**. The sporophytic imcompatibility is due to the genotype of the sporophytic incompatibility is due to the genotype of the sporophytic stigmatic tissues. Gemetophytic imcompatibility occurs due to genotype of the pollen. Reasons for incompatibility are prevention of pollen germination, retardation of growth and deorientation of pollen tube. It may even take place due to **failure of nuclear fusion**. It is controlled by genes with **multiple alleles (S-allele)**. Mostly it may develop with the maturation of stigma (Noll 1902).

138. What is bagging technique ? How is it useful in a plant breeding programme ?

Ans : OD 2013

Bagging: The emasculated flowers are covered by a **bag**, made of butter paper. It is done to prevent contamination of the stigma with other pollens. By this technique pollination is brought about by the use of desired pollen grains.

139. What is triple fusion? Where and how does it take place? Name the nuclei involved in triple fusion.

Ans : OD 2015

In the embryo sac, one of the two male nuclei fuses with the egg nucleus and forms a **diploid zygote**. This process is called **syngamy**, while the other male nucleus fuses with the two polar nuclei (or secondary diploid nucleus) and gives rise to a triploidy nucleus called the **primary endosperm nucleus**. This process of nuclear fusion is known as **Triple fusion**. The product of primary endosperm nucleus is endosperm.

140. What do you think the zygote is dormant for sometime in a fertilized ovule ?

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Ans : SQP 2012

The zygote develops into an embryo. The zygote is dormant for sometime in a fertilized ovule because mostly zygote divides only after some amount of endosperm is formed. This is for assured nutrition to the developing embryo.

141. Differentiate between Hypocotyl and Epicotyl

Ans : COMP 2005

Difference between Hypocotyl and Epicotyl are as follows :

	Hypocotyl		**Epicotyl**
1.	This is the cylindrical part of embryo lying below cotyledon stalk.	1.	This is a part of embryo lying above cotyledon stalk.
2.	Its tip is radicle or **root tip**.	2.	Its tip is plumule or **stem tip**.
3.	It terminates at its lower end in root tip, covered by root cap.	3.	It has a shoot apex and a few feaf primordia.

142. Differentiate between Coleptile and Coleorrhiza

Ans : DELHI 2005

Difference between Coleoptile and Coleorhiza are as follows:

	Coleoptile		**Coleorhiza**
1.	This is a protective covering of the plumule.	1.	This is a protective covering of radicle.
2.	Epicotyl has shoot apex and a few leaf primordia enclosed in a hollow foliar structure, called as coleoptile.	2.	Embryonal axis has a radicle and root tip enclosed in a sheath called, coleorhiza.

143. Differentiate between Integument and Testa

Ans : FOREIGN 2017

Difference between Integument and Testa are as follows :

	Integument		**Testa**
1.	There are 2 integuments of ovule.	1.	The integument of ovule hardens to form the testa (outer covering) of seed.
2.	Integument is protective in function. Integuments encircle ovule except at tip.	2.	It provides protection to the young embryo.

144. Differentiate between Perisperm and Pericarp

Ans : COMP 2009

Difference between Perisperm and Pericarp are as follows :

	Perisperm		**Pericarp**
1.	Wall of ovary develops into the wall of fruit called the pericarp.	1.	It is the remnant of nucellus.
2.	In mango, pericarp is three layered-epicarp, mesocarp and endocarp.	2.	It is residual and persistent nucellus. Remnants of nucellus are observed in beet and black peeper.

145. Why is the apple called a false fruit? Which part(s) of the flower forms the fruit?

Ans : FOREIGN 2011, COMP 2015

The fruits developed from other non-essential parts of the flower (such as sepals, petals, thalamus etc.) are called '**false fruit**' or '**Pseudocarpic fruits**'. **Example:** Apple (Thalamus is edible).

146. What is meant by emasculation ? When and why does a plant breeder employ this technique ?

Ans : COMP 2013

Emasculation is defined "as the removal of anthers from the flower bud before anther dehisces". It is done by the help of a forecep.

It is done for **artificial hybridization** in plants. It is an approach for **crop improvement** by plant breeders. The superior varieties are produced by it. For crossing experiments, only desired pollens are used of pollination. The stigma is protected from unwanted pollen or from the contamination.

147. Explain the role of tapetum in formation pollen-grain wall.

Ans : OD 2007, DELHI 2010, SQP 2005

The cells of tapetum have dense cytoplasm. The cells have mostly more than one nucleus. Tapetum is the inner most wall layer of anther. It nourishes the **pollen grains**. Outer to it are three wall layers.

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These are protective and help in **dehiscence** of anther to release pollen grains from it.

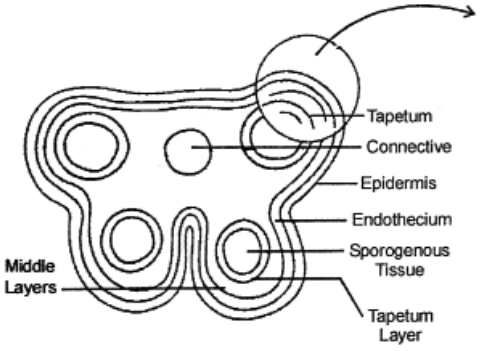
148. What is apomixis and what is its importance?

Ans : DELHI 2005

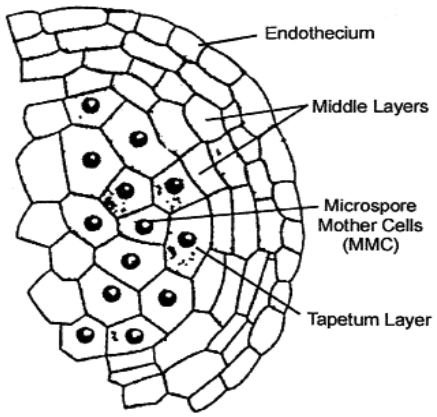
Apomixis refers "to the development of seeds without fertilization." It is a form of asexual reproduction. It **mimics** to the sexual reptoduction of higher plants.

Importance of Apomixis :

1. Apomixisits have many advantages in agriculture and horticulture.
2. It has increased productivity.
3. It is important in hybrid seed industry.



(a)



(b)

Fig (a) Transverse section of a mature anther, (b) Enlarged view of one microsporangium showing wall layers.

149. If one can induce parthenocarpy through the application of growth substances, which fruits you would select to induce parthenocarpy and why ?

Ans : DELHI 2010

Parthenocarpy is defined "as the development of fruit from an unfertilized ovary." The fruit is seedless e.g., apple, pear, banana and pine apple.

1. In some diploid egg cell without meiosis develops into embryo without fertilization.
2. In Citrus and mango varieties, cells from the nucellus enclosing embryo sac begin to divide and protude into embryo sac and develop into embryo.
3. Growth regulators induce parthenocarpy in litchi and mango.

150. List three strategies that a bisexual chasmogamous flower can evolve to prevent self-pollination (autogamy).

Ans : FOREIGN 2005

1. Anthe and stigma lie at different positions so that pollen cannot come in contact with stigma of same flower.
2. The pollen is released before the stigma becomes receptive or stigma became receptive before release of pollen grain.
3. Self-incompatibility.

151. Does self incompatibility impose any restrictions on autogamy? Give reasons and suggest the method of pollination in such plants.

Ans : OD 2013

Self incompatibility **prevents** autogamy and in breeding production of unisexual flowers prevent self pollination in them; when male and female flowers are born on some plant as in papaya and maize, this prevents autogamy but not **geitonogamy** (a method of pollination in such plants).

152. What is polyembryony and how can it be commercially exploited?

Ans : DELHI 2014

"Occurrence of more than one embryo in a seed is" called **polyembryony** e.g., Orange seeds. The farmers use hybrid seeds to develop a new crop year after year and they need not purchase hybrid seeds; Apomictic genes can be transferred into hybrid varieties of seeds.

153. Are parthenocarpy and apomixis different phenomena? Discuss their benefits.

Ans : OD 2005

Parthenocarpy and apomixis are different phenomenon the **apomixis** leads to development of embryo; panthenocarpy leads to development of **seedless fruit** in apple, pear, bananas etc., it can be **induced** in **tomatoes**. Apomixis is related to **polyploidy**.

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154. Why does the zygote begin to divide only after the division of Primary endosperm cell (PEC)?

Ans : **COMP 2007**

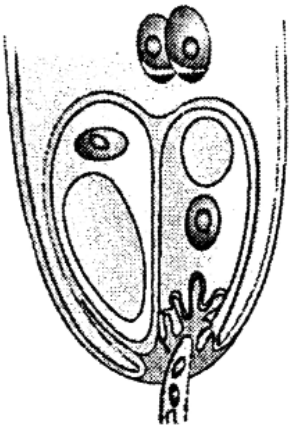
The zygote needs nourishment during its development. As the mature, fertilised embryo sac offers very little nourishment to the zygote, the PEC divides and generates the endosperm tissue which nourishes the zygote. Hence, the zygote always divides after division of PEC.

155. The generative cell of a two-celled pollen divides in the pollen tube but not in a three-celled pollen. Give reasons.

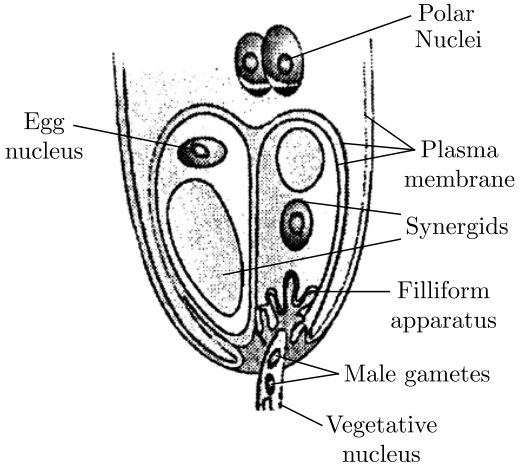
Ans : **FOREIGN 2012**

In a 3-celled pollen, the generative cell has already divided and formed 2 male gametes. Hence, it will not divide again in the pollen tube. Since in a 2-celled pollen, the generative cell has not divided, it divides in the pollen tube.

156. In the figure given below label the following parts: male gametes, egg cell, polar nuclei, synergid and pollen tube.



Ans : **SQP 2007**



157. What are characteristic features of insect pollinated flowers?

Ans : **DELHI 2012, SQP 2019**

The characteristic features of insect pollinated flowers are as follows :

1. Flowers are large sized, brightly coloured and showy.
2. Pollen grains are sticky.
3. Flowers are sweet scented.
4. Pollen grains of such flowers may be edible.
5. Some flowers also produce nectar.

158. Give characteristic features of wind pollinated flowers.

Ans : **FOREIGN 2005**

The characteristics features of wind pollinated flowers are as follows :

1. Flowers are colourless, odourless and Nectarless.
2. Large number of pollen grains are produced by such flowers.
3. Pollen grains are light, dry, non-sticky or even winged.
4. Stigmas are large, hairy or feathery.

159. What features are present in Ornithophilous flowers?

Ans : **COMP 2006**

Such flowers possess bright petals. They produce large amount of nectar. The corolla is tubular and stores nectar. Birds visit such flowers to suck nectar and thus help in pollination.

160. Why the endosperm is triploidy and what is its importance?

Ans : **OD 2010**

Endosperm of angiosperms is produced from the primary endosperm cell a product of triple fusion. Two polar nuclei and one male nucleus get fused together and their product develops into endosperm. It supplies nourishment to the developing embryo. It also provides nourishment to germinating seeds with endosperm.

161. What is the structure of a monocot embryo?

Ans : **DELHI 2015**

Embryos of monocots possess only one cotyledon called **scutellum**. It is situated on the lateral side of the embryo axis. At its lower end, the embryo axis has radical and root cap. It is enclosed in a sheath called **coleorhiza**. The portion of embryonal axis above the level of attachment of scutellum is the **epicotyl**. It has a shoot apex enclosed in hollow foliar structure called **coleoptile**.

NODIA

162. How does pollination occur in Mediterranean orchid?

Ans : SQP 2009

In this orchid plant the pollination takes by a wasp **Copla aurea**. The shape of this orchid flower resembles closely to the female wasp and also emits some type of odour. The male wasp in thus attracted to the flower and enters it for copulation and thereby **cross-pollination** takes place.

163. Explain the significance of seeds and fruit formation.

Ans : FOREIGN 2020

Significance of Seed and Fruit Formation are as follows :

1. In angiospermic plants **fruits** enclose the **seeds**. They **protect** seeds from unfavourable **climatic** conditions at all.
2. The fruits may by **fleshy** or **dry**. Both of these help in **dispersal of seeds** to distant places.
3. Fruits are **sources** of several chemicals like oils, organic acids, proteins, sugars, minerals as well as the vitamins.
4. Certain fruits provide food/nourishment to **developing seedlings**.
5. In **gauva**, the **hard seed coat** is enclosed by fleshy, soft fruit pericarp.
6. In **almond**, soft seeds are enclosed by **hard fruit shell**.
7. Edible and fleshy parts of fruits are **sources** of **food** and **energy** to us and other animals.
8. Animals help in dispersal of seeds and fruits by eating edible fleshy fruits.

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164. Write the advantages of cross pollination.

Ans : FOREIGN 2005

Advantages of Cross Pollination are as follows :

1. Improved varieties are produced.
2. Introduction of variations in species of plants.
3. Production of healthy and vigonous seeds.
4. Seed yield may be high.

165. Differentiate between perisperm and endosperm giving one example of each.

Ans : COMP 2020, OD 2023, DELHI 2021

Differentiate between perisperm and endosperm are as follows :

	Feature	Perisperm	Endosperm
1.	Consumption or persistence	It is the remains of the nucellus in a seed.	Endosperm may be consumed by developing embryo; it may persist in castor and coconut seeds.
2.	Examples	Black pepper and beet seeds have perisperm.	Pea and groundnut seeds.

166. Make a list of any three outbreeding devices that flowering plants have developed and explain how they help to encourage cross-pollination.

Ans : SQP 2009, FOREIGN 2010, COMP 2013

Three out-breeding devices to encourage cross pollination :

1. **Release** of pollen grains even before the stigma becomes receptive.
2. Stigma may become **receptive** before release of pollen grains. Anther and the stigma are placed (lie) at different positions. Pollens do not come in contact with stigma of same flower in same plant species.
3. **Self-incompatibility** and production of uni-sexual flowers etc. Self incompatibility prevents pollen from fertilising the ovule because there is no pollen germination on the pistil.

167. What is the role of endothecium and tapetum in an anther?

Ans : OD 2015

Role of Endothecium are as follows :

1. Protection.
2. Helpful in dehiscence of anther.

Role of Tapetum: Tapetum is the inner most wall layer of anther. It **nourishes the pollen grains** and outer to it are **three wall layers**.

168. Define apomixis. How is it different from polyembryony?

Ans : DELHI 2006

Apomixis : It refers "to the development of seeds without fertilization". It is a form of asexual reproduction. It **mimics** to the sexual reproduction of higher plants.

Difference between Apomixis and Polyembryony

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are as follows :

	Apomixis	Polyembryony
1.	Development of seeds without fertilization.	It is occurrence of more than one embryo in a seed.
2.	Example: some species of grasses and Asteraceae family.	e.g., Citrus, mangoes.

169. Define parthenogenesis. Give one example of parthenogenesis from plants and one from animals.

Ans : SQP 2007

Parthenogenesis is defined "as the development of egg without fertilization". Seeds develop from unfertilized female gamete in plants e.g. some terrestrial orchids and Dendelion. Parthenogenesis occurs in animals too e.g. Aphids, **Natural parthenogenesis (thelokoty)** occurs in Lacerta saxicola and **artificial parthenogenesis** in Echinus an Echinodemata.

170. Explain how pollination takes place in Zostera marina?

Ans : FOREIGN 2010

Zostera marina is a submerged marine plant which shows **true hydrophily**. The pollination takes place beneath the surface of water. The pollen grains released are elongated, needle like, without an exine and float beneath the surface of water. On reaching the stigma they coil around it and germinate.

171. What are the contrivances for cross pollination?

Ans : COMP 2012

Contrivances for cross pollination:

1. **Dicliny (unisexuality):** Stamens and the carpels occur on different flowers e.g., mulberry, betel, maize, castor, Euphorbia carica, Cannabis etc.
2. **Incompatibility:** It is called **self sterility**. The pollens of one flower can not fertilize the egg of same flower. e.g., tea flower, passion flower, Potato, Malva etc.
3. **Dichogamy:** In bisexual flowers stamen and carpel do not mature at the same time e.g., Rose, sunflower etc.
4. **Heterostyly:** It is a special device to ensure cross pollination in those plants where stamen and carpal mature at same time. Some have long style but short stamens. These are called pin eyed. Some possess short style but long stamen. These are called **thrum-eyed**.

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172. Explain the different ways apomictic seeds can develop. Give an example of each.

Ans : OD 2015

Development of Apomictic Seeds:

(a) Diploid (2N) egg is formed without meiosis in some species. It develops into the **embryo** without the process of fertilization.

(b) In some plants e.g., Mango and Citrus-in the varietis **nucellar cells** enclosing embryo sac begin to divide; they protrude into embryo sac; then develop into embryos. Ovule may have several embryos, showing polyembryony e.g., orange.

173. How is artificial hybridization considered a crop improvement programme?

Ans : DELHI 2019

Artificial Hybridization is considered a crop improvement programme in which "the different species as well as the Genera are crossed for combination of desirable traits to get commercially superior varieties of organisms." The desired pollens are protected from the unwanted ones by emasculation and **bagging**.

174. Explain the process of artificial hybridization if

(a) female parent bears bisexual flower.

(b) female parent bears uni-sexual flower.

Ans : SQP 2019

(a) **Female Parent Bears Bi-sexual Floweres:** Anthers are removed from flower bud before its dehiscence by forceps. It is known as emasculation. It is followed by **bagging** of esmasculated flowers to prevent from undesired pollen grains. At attaining receptivity, mature pollens are dusted from anthers of a male parent on stigma. The flowers are bagged again to develop of fruits.

(b) **Female Parent Produces Unisexual Flowers:** In this case, **female flower buds** are **bagged** before **opening of flower**. The stigma become receptive and then desired pollens are dusted on stigma. Now the flower is bagged again to develop fruit.

175. Name the parts of the ovule and the embryo sac for an angiosperm that develop into- 1. perisperm, 2. seed coats, 3. endosperm, 4. embryonal axis.

Ans : FOREIGN 2021

1. **Perisperm:** In black pepper and coconut **nucellus of ovule** may persist as perisperm.
2. Seed coats: One opening is called micropyle.
3. **Endosperm: PEM** develops into it by triple fusion.

4. **Embryonal axis:** Zygote formed by fusion of male and female gametes give rise to embryo that has embryonal axis (its part is epicotyl in dicot seed and sentellum in maize grain (monocot seed).

176. What are pollen grains ? Give their structure.

Ans : COMP 2023

Pollen Grains has 2 layered wall made of intine and exine. Outer hard layer is exine that is made up of sporopollenin. It has germ pores. The exine shows fascinating array of patterns and designs.

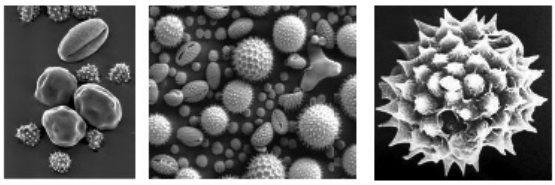

Fig Scanning EM of a few pollen grains

The inner wall of a pollen is intine that is thin and consists of cellulose and pectin. The cytoplasm is enclosed by plasma membrane. Mature pollen grain in 2 celled. When generative cell divides, it becomes 3-celled.

177. Write note on their economic importance.

Ans : OD 2018

(a) Pollens of some species cause **allergy** and **bronchial** affictions leading to **asthma, brochitis** in people.

(b) Pollens are used as food supplements. They are available as tablets and syrup in markets.

178. State one advantage and one disadvantage of cleistogamy.

Ans : DELHI 2019

(a) **Advantage:** Cleistogamous flowers produce assured seed-set in absence of the pollinators.

(b) **Disadvantage:** There is no chance of cross pollen landing on stigma of cleistogamous flower.

179. How does the study of different parts of a flower help in identifying wind as its pollinating agent?

Ans : COMP 2005

The wind pollination needs **light** and **non-sticky** pollen grains which are transported easily by air. The flowers have well exposed stamens, single ovule in each ovary and many flowers packed into inflorescence e.g. corn cob and grasses.

180. Explain the structure of a dicot seed say gram seed.

Ans : COMP 2010

A Dicot Seed (e.g., Gram Seed): Gram seed has 2 **cotyledons**. The dicot seeds are of two types : 1. endospermic and 2. non endospermic.

1. **Endospermic Seed :** e.g., castor and custard apple seeds. It has endosperms. It has outer hard black mottled shell, the testa (seed coat). **Caruncle** is an outgrowth at the **micropyle**. It is spongy and absorbs moisture during seed germination. The **raphe** is prominent. The perisperm is a thin papery layer enclosing the **endosperm**. It has 2 cotyledons hinged to the axis, the **tigellum** that shows a radicle and a plumule between cotyledons.
2. **Non-endospermic Seed :** e.g., gram, pea, bean etc. These are covered by **seed coat**. **Seed coat** is mostly made up of 2 layers 1. **testa (outer)** and 2. tegmen (inner). Seed is attached to stalk at the point hilum. The **micropyle** is above the hilum. **Raphe** is distinct. The embryo possesses **tigellum** (axis) and two fleshy cotyledons (fell of reserve food). Radicle is lower point of axis while plumule is upper leafy end of the embryonal.

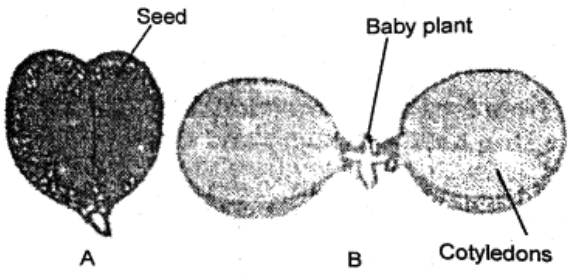

Fig Structure of gram seed (A) and (B)

181. Explain the following:

1. Malacophily
2. Chitopterophily
3. Hydrophily
4. Anemophily

Ans : FOREIGN 2005

1. **Malacophily:** Pollination by snails is malacophily. Example-Arisaeme (Cobra plant).
2. **Chitopterophily:** Pollination by bat is chitopterophily. e.g., Kigelia pinnata.
3. **Hydrophily:** Pollination by water is hydrophily. e.g., Zostera and Vallisnaria.
4. **Anemophily:** Pollination by wind is termed as anemophily. e.g., Maize and coconut, palm, apple, peach.

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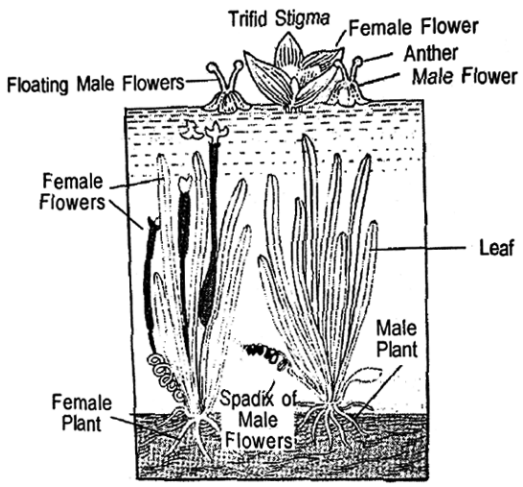


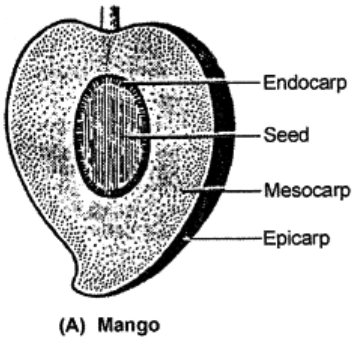
Fig Vallisneria-pollination by water

182. What is a fruit? Describe various zones of fruit by taking any example of succulent fruit.

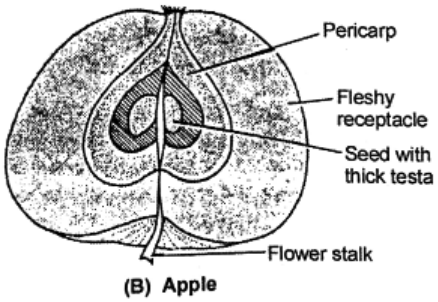
Ans : **SQP 2012**

Fruit is regarded as a ripened ovary. But sometimes, other floral parts also take part in the formation of fruits e.g., in apple, the main edible portion of fleshy receptacle and such fruits are called as false fruits.

A succulent fruit like mango consists of pericarp and the seed. The pericarp is divided into three zones: epicarp, mesocarp and the endocarp. In mango, the outer skin is epicarp. The sweet, pulpy and edible portion is mesocarp. The endocarp is hard in drupes.



(A) Mango



(B) Apple

Fig (A) A fruit of mango: Cut open to show mesocarp surrounded on outside by a thin epicarp and on inside by endocarp, (B) False fruit of apple cut open to show internal structure

183. Mention any four strategies adopted by flowering plants to prevent self pollination.

Ans : **FOREIGN 2011**

Four strategies adopted by flowering plants to prevent self pollination:

(a) The pollen is released before the stigma is receptive.

(b) The anther and stigma are placed at different position and the pollen does not come in contact with stigma of the same flower.

(c) Self incompatibility prevents self pollination.

(d) Production of uni-sexual flowers.

184. Draw a labelled diagram of the sectional view of a mature pollen grain of angiosperms. Explain the function of any two of its parts.

Ans : **Delhi 2005**

1. **Exine:** Can withstand the high temperature and strong acids/as well as the alkalies.
2. **Intine:** Is a thin but continuous layer consisting of cellulose and pectin.
3. **Vegetative Cell:** Is bigger, has abundant food reserve.
4. **Generative Cell**: Divides by meiosis to give rise to two male gametes.

Sectional view of a Mature Pollen Grain :

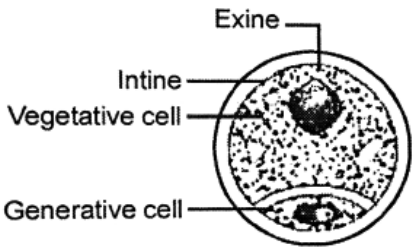


Fig Sectional view of mature pollen grain of an angiosperm flower

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185. Differentiate between Simple, Aggregate and Composite fruits.

Ans : **OD 2005**

The difference between Simple, Aggregate and Composite fruits are as follows :

	Simple Fruits	**Composite Fruits**	**Aggregate Fruits**
1.	They develop from a single ovary.	They develop from the inflorescence.	They develop from polycarpellary and apocarpous carpel.
2.	The ovary may be monocarpellary, polycarpellary and syncarpous.	They are known as multiple fruits.	Each ovary develops into a fruitlet and several fruitlets make aggregate fruit.
3.	Example is pea.	Example is pine apple, and mulberry.	Example is strawberry.

186. How does a plant breeder ensure cross-pollination in economically important bisexual flower?

Ans : **DELHI 2010, SQP 2011**

It is done by emasculation and bagging techniques by a breeder. Female parent bears bisexual flowers, the anthers are removed from flower bud by a forcep before the anther dehisces. It is called emasculation.

The emasculated flowers are then covered by a bag made of butter paper to prevent contamination of unwanted pollens. Mature pollens collected from anther of a male parent are then dusted on stigma. The flower is again bagged. The fruit is permitted to develop.

187. Continuous self-pollination results in inbreeding depression in plants. Describe any three devices by which cross pollination is encouraged in nature.

Ans : **FOREIGN 2013**

Continuous self-pollination results in inbreeding depression :

To check it, there are three devices :

1. Production of unisexual flowers.
2. In some plant species like papaya, male and female flowers are found on separate plants to prevent autogamy.
3. Third device is self-incompatibility.

188. Explain any three advantages the seeds offer to Angiosperms.

Ans : **FOREIGN 2005**

Seeds Offer Advantages to Angiosperms :

1. The reproductive processes like pollination and fertilization are independent of water (H_2O), the seed formation is more dependable at all.
2. Seeds possess better adaptive strategies for their dispersal to new habitats/places. It is essential for conditioning them in new areas.
3. They produce new genetic combinations which lead to variations.

189. Why are angiosperm anthers called dithecous? Describe the structure of its microsporangium.

Ans : **COMP 2010**

Dithecous Anther : The anther of an angiosperm is bilobed. Each lobe possesses 2 theca. Mostly a longitudinal groove sepaates these theca. The anther contains 4 microsporangia on its 4 corners. Microsporangia later on change into pollen sacs. Each microsporangium is **circular** in shape in outline. It remains surrounded by 4 wall layers. They are **epidermis, endothecium, middle layers** and **tapetum**.

Tapetum serves the function of nutrition. Other three layers protect the pollen grains and are helpful in dehiscence of anther, thereby in release on pollen grains.

190. Explain triple fusion in angiosperm.

Ans : **OD 2017**

Triple Fusion : In the embryo sac, one of the two male nuclei fuses with the egg nucleus and forms a diploid zygote. This process is called **syngamy**, while the other male nucleus fuses with the two **polar nuclei (secondary diploid nucleus)** and gives rise to a **Triploidy nucleus** called the **primary endosperm nucleus**. This process of nuclear fusion is known as **Triple fusion**. The product of primary endosperm nucleus is **endosperm**, which results after division of primary endosperm nuclei and development of wall around three nuclei.

191. Write the fate of the products of this fusion in the mature fruit of coconut.

Ans : **DELHI 2012**

Coconut Fruit : PEC developed into endosperm. PEC divides quickly to make tissue of endosperm. PEN undergoes successive nuclear divisions to form **free nuclei**; this stage is called **free nuclear endosperm** (coconut water) that is made up of thousands of nuclei and enclosing white kernel is cellular endosperm.

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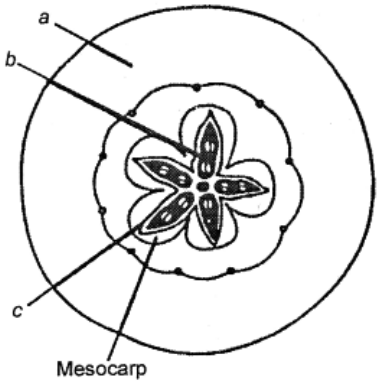
192. Given below is a T.S. of an apple. Identify a, b and c. Why is an apple categorised as a false fruit?



Ans : SQP 2008

a = Thalamus, b = Seed, c = Endocarp.

Apple is called false fruit because along with ovary, thalamus takes part in fruit formation (true fruit is formed only from ovary).

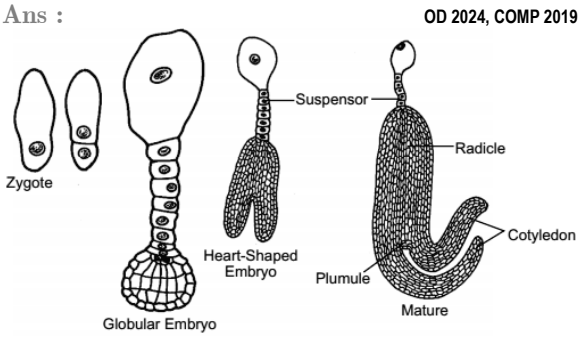
193. Both coconut palm and date palm produce staminate flowers. One is monoecious and the other is dioecious. Write the difference.

Ans : FOREIGN 2016

Monoecious	Dioecious
Male and female flowers occur on the same individual e.g., Coconut palm.	Male and female flowers occur on different individuals e.g. date palm.

194. Starting with the zygote, draw the diagrams of the different stages of embryo development in a dicot.

Ans : OD 2024, COMP 2019



195. What are the possible types of pollinations in chasmogamous flowers? Give reasons.

Ans : OD 2008

Chasmogamous Flower: Agents of pollination may be abiotic (wind, water) or biotic (animals). Wind pollination needs light and non-sticky pollens, easily carried by wind, well exposed stamens etc. (e.g. grasses). Pollination by water mostly occurs in monocots and Zostera etc., flowers emerge on surface of water and pollen reach there. Insects are pollinating agents also. Some animals are pollinators.

196. Differentiable between the two cells enclosed in a mature male gametophyte of an angiosperm.

Ans : DELHI 2005

Mature male gametophyte is pollen grain. It contains two cells that is vegetative cell and generative cell.

Difference between vegetative cell and generative cell:

	Vegetative	Generative
1.	It is bigger in size. It contains enough food reserves.	It is small in size. It floats in the cytoplasm of vegetative cell.
2.	Its nucleus is irregular in shape.	It has dense cytoplasm and a nucleus.

197. Write the changes a fertilized ovule undergoes within the ovary in an angiosperm plant.

Ans : SQP 2012

Changes in Fertilized Ovule: The zygote develops into embryo. Ovary forms the fruit, ovary wall becomes the pericarp. Ovary is changed into seed. Funicle becomes the stalk of seed. Outer intergument of ovule forms testa while the inner integument makes the tegmen. The accessory parts of flower fall off. In some cases, some parts develop into fruit. e.g., apple (false fruit).

198. Differentiate between autogamy, geitonogamy and xenogamy.

Ans : FOREIGN 2013

The difference between Autogamy, Geitonogamy and Xenogamy are as follows :

	Autogamy	Geitonogamy	Xenogamy
1.	Pollination of ovule by pollens of some flower. Plants breed true e.g., **pea**.	Transfer of pollens from an anther of a flower to stigma of another flower of same plant.	It is called **allogamy**/ crosspollination.
2.	It does not provide genetic viability and the recombination.	It does not provide genetic viability and genetic recombination e.g., **wheat**.	It provides the opportunities for genetic recombination e.g., **maize** plant.

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199. Write the characteristic features of anemophilous flowers.

Ans : COMP 2010

Characteristics of Flowers that Facilitate Wind Pollination (Anemophily):

(a) **Wind pollinated** (anemophilous) flowers are **light, non-sticky** but may be **winged** sometimes.

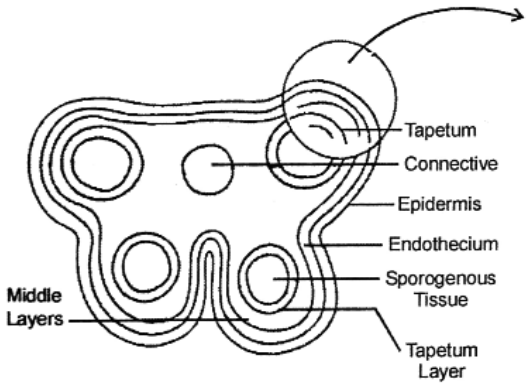
(b) Anthers well exposed for easy dispersal of pollens and the stigmas are mostly large as well as feathery to trap air borne pollens.

(c) The flowers become arranged as an inflorescence.

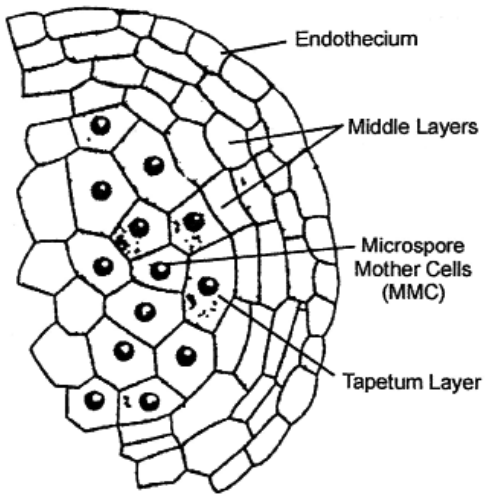
(d) Normally the flowers have a single ovule e.g., some grasses and maize plant.

200. Draw a labelled diagram of a transverse section of a mature anther of an angiosperm showing different wall layers.

Ans : OD 2008



(a)



(b)

Fig (a) Transverse section of a mature anther of an Angiosperm, (b) Enlarged view of one microsporangium showing wall layers

201. Draw a diagrammatic sectional view of a mature anatropous ovule and label the following parts in it :

(a) that develops into seed coat.

(b) that develops into an embryo after fertilization.

(c) that develops into an endosperm in an albuminous seed.

(d) through which the pollen tube gains entry into the embryo sac.

(e) that attaches the ovule to the placenta.

Ans : SQP 2015

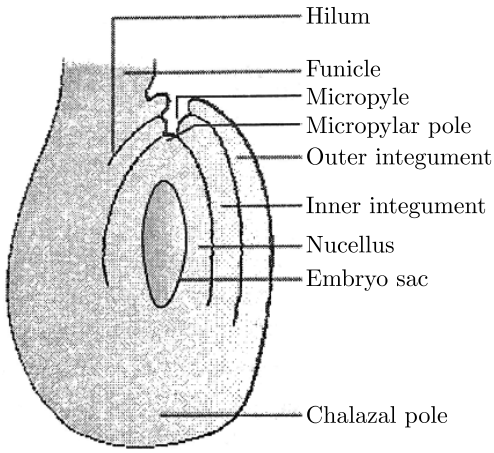


Fig A diagrammatic sketch of the view of anatropous ovule

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202. Mention the function of each of these wall layers during pollen grain development.

Ans : DELHI 2012

The **Anther** remains enclosed by **four wall** layers that is (a) epidermis, (b) endothecium (c) middle layers and (d) tapetum during pollen grain development.

(a) **Function of Epidermis:** Protection as well as help in dehiscence of anther.

(b) **Function of Endothecium:** Protection; are helpful in dehiscence of anther.

(c) **Function of Middle Layers:** Protection; help in dehiscence of anther for releasing pollen grains.

(d) **Function of Tapetum:** It nourishes the pollen grains at developing stage.

203. Describe the characteristic features of wind pollinated flowers.

Ans : FOREIGN 2007

Characteristics of Flowers that Facilitate wind Pollination:

(a) Wind pollinated flowers are light, non-sticky buy may be winged sometimes.

(b) Anthers well exposed for easy dispersal of pollens and the stigmas are mostly large as

well as feathery to trap air borne pollens.

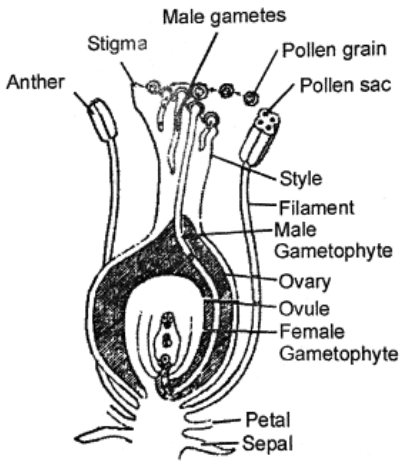
(c) The flowers become arranged as an inflorescence.

(d) Normally the flowers have a single ovule e.g., some grasses and maize plant.

204. Draw a L.S. of a pistil showing pollen tube entering the embryo-sac in an angiosperm and label any six parts other than stigma, style and ovary.

Ans : **COMP 2006**

L.S. of a Flower



205. Pistil of a flower does not accept pollen from any plant other than from its own kind. How does it happen? Explain.

Ans : **OD 2013**

Ability of pistil to accept pollen grains of its own kind is mediated by the interaction between chemical components secreted by pollen as well as those of the pistil.

206. Mention the function of each of the following :

1. tassels of corn-cob
2. mitochondria in sperm
3. tapetum in the microsporangium.

Ans : **DELHI 2015**

Functions of:

1. **Tassels of Corn-cob:** It waves in air to trap pollen grains for wind pollination.
2. **Mitochondria in Sperm:** It provides energy for movement of tail.
3. **Tapetum in the Microsporangium:** It nourishes the developing pollen grains in anther.

207. Distinguish between Apomixis and Amphimixis.

Ans : **SQP 2020**

Difference between Apomixis and Amphimixis are as follows :

	Apimixis		**Amphimixis**
1.	Any asexual method of propagation not involving normal production of embryo by fertilization is known as apomixis.	1.	Sexual reproduction by fusion of gametes and formation of normal embryo is known as amphimixis.
2.	**Examples:** Vegetative propagation through bulbs, thubers, bulbils, adventitious buds.	2.	**Examples** are rice and wheat.

208. Distinguish between Monocot Seed and Dicot seed.

Ans : **FOREIGN 2023**

Difference between Monocot Seed and Dicot Seed are as follows:

	Monocot Seed		**Dicot Seed**
1.	It has one cotyledon.	1.	It has two cotyledons.
2.	Aleurone layer present.	2.	Absent.
3.	Radicle and plumule covered by coleorrhiza and coleoptile.	3.	Absent.
4.	Food stored in endosperm.	4.	Food stored in cote-ledon or endosperm.
5.	e.g. Maize and wheat seeds.	5.	e.g. Beam seed.

209. Describe the endosperm development in coconut.

Ans : **COMP 2011**

The Development of Endosperm in Coconut: **PEN** (Primary Endoplasm Nucleus) undergoes successive nuclear division. This gives rise to **free-nuclei**. It is called **free-nuclear endosperm-development**. The cell wall formation takes place and now the endosperm becomes cellular. Number of free nuclei formed differ greatly. The **coconut water** if **free-nuclear-endosperm**. It is made up of thousands of nuclei. The surrounding white kernel is **cellular endosperm**. Endosperm may persist in mature seed in angiosperm.

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210. Distinguish between Autogamy and Allogamy.

Ans : SQP 2010

Difference between Autogamy and Allogamy are as follows :

	Autogamy		Allogamy
1.	Pollination of the ovule by the pollen grains of the same flower is termed as autogamy.	1.	Pollination of the ovule by the pollen grains of another flower of a different plant is termed as allogamy.
2.	It does not provide opportunity for genetic recombination and genetic variability.	2.	It provides many opportunities for genetic recombination and greater variability.
3.	Autogamous plants breed true to their type, e.g., pea, wheat, rice.	3.	Allogamous plants show hybrid vigcur, e.g., maize, Cannabis, mulberry.

211. Why is tender coconut considered a healthy source of nutrition?

Ans : OD 2009

The endosperm is filled with reserve food materials and is used for nutrition. The coconut water from the tender coconuts if free nuclear endosperm. It is made up of several thousands nuclei. It is enclosed by white kernel that is cellular endosperm.

212. How are pea seeds different from castor seeds with respect to endosperm?

Ans : DELHI 2006

Pea Seeds Differ from Caster Seeds: The **pea seeds** are **non-albuminous** that has no residual endosperm since that is fully consumed during embryo development. The **castor seeds** are **albuminous** as they retain a portion of endosperm since it is not completely used be embryo for its development.

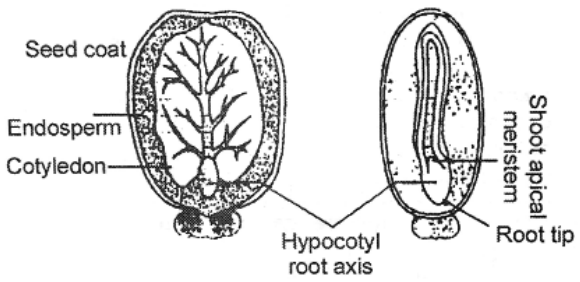

Fig Castor seed

213. Draw a labelled diagram of a male gametophyte of an angiosperm. Why does it possess two male gametes to fertilize an ovule?

Ans : FOREIGN 2014

Male Gametophyte of an Angiosperm :

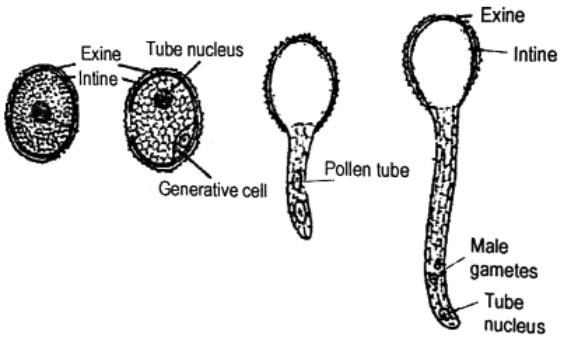

Fig Mature pollen grain and development of male gametophyte

It possesses 2 male gametes to fertilize one ovule because one of these male gametes fuses to egg cell to form **zygote**. It is called **syngamy (fertilization)**. The other male gamete moves towards two polar nuclei (located in the central cell) and fuses with them to form a triploidy primary endosperm nucleus i.e. PEN.

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214. In angiosperms, zygote is diploid while primary endosperm cell is triploidy. Explain.

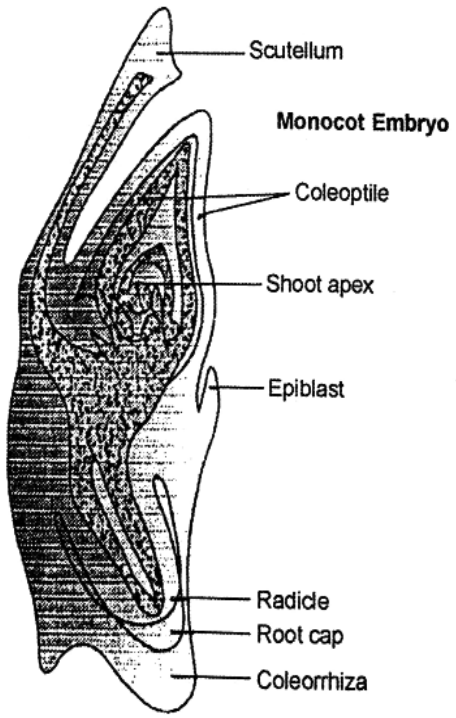
Ans : DELHI 2015

Embryo sac, Zygote and Endosperm in Angiosperm: The embryo sac is haploid since it contains haploid egg cell that is formed by meiosis division of MMC of the ovule. The zygote is diploid since it is formed by fusion of male gamete and female gamete (both these are haploid). The endosperm is triploidy since it is formed after triple fusion that is fusion of male gamete with two polar nuclei.

215. Draw a labelled diagram of L.S. of an embryo of grass (any six labels).

Ans : COMP 2015

L.S. of an Embryo of Grass :



216. Give reasons for each of the following

(a) Anthers of angiosperm flowers are described as dithecous.

(b) Hybrid seeds have to be produced year after year.

Ans : OD 2014

(a) **Anthers of Angiosperms Flowers are Dithecous:** A typical angiospermic anther is bilobed. Each lobe has 2 theca-So it is known as dithecous. A longitudinal groove separates the 2 anthers.

(b) **Hybrid Seeds have to be Produced Year After Year:** The reason is that when seed of hybrids are sown the plants of progeny will segregate as well as they don't maintain characters of hybrid. When these are made into the apomicts, then there occurs no segregation at all.

LONG ANSWER QUESTIONS

217. What do you understand by double fertilization? Explain it with the help of diagrams.

Or

Describe fertilization in flowering plants.

Ans : OD 2017, DELHI 2011

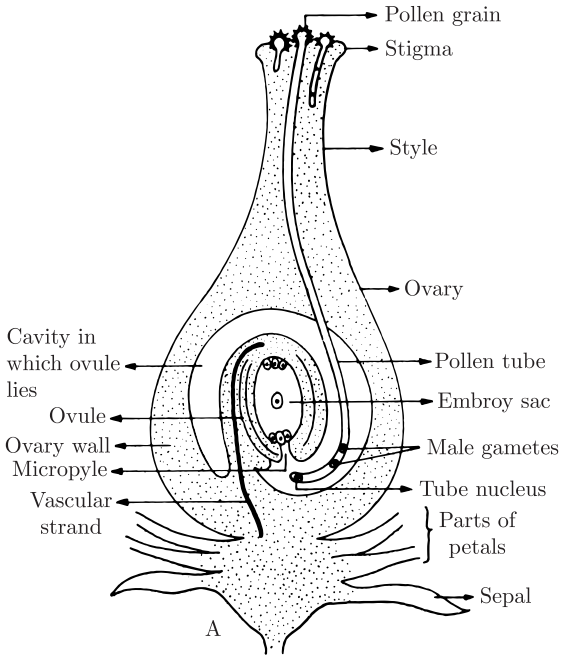
In flowering plants pollen tube, after reaching the ovary, enters the ovule through the micropyle and then enters one of the synergids through the filiform apparatus. The filiform apparatus present at the micropylar part of the synergids guides the entry of pollen tube.

After entering one of the synergids, the pollen tube releases the two male gametes into the cytoplasm of the synergid. One of the male gametes moves towards the egg cell and fuses with its nucleus thus completing the syngamy. This results in the formation of a diploid cell called zygote.

While other male gamete moves towards the two polar nuclei located in the central cell and fuses with them to produce a triploidy primary endosperm nucleus (PEN). It is termed as triple fusion because this involves the fusion of three haploid nuclei.

Since two types of fusions, syngamy and triple fusion take place in an embryo sac therefore this phenomenon is termed double fertilization. This event is unique to angiosperms.

The central cell after triple fusion becomes the primary endosperm cell (PEC) and develops into the endosperm that provide nourishment to the growing embryo plant while the zygote develops into an embryo.



Longitudinal Section of Pistil showing Pollen Germination

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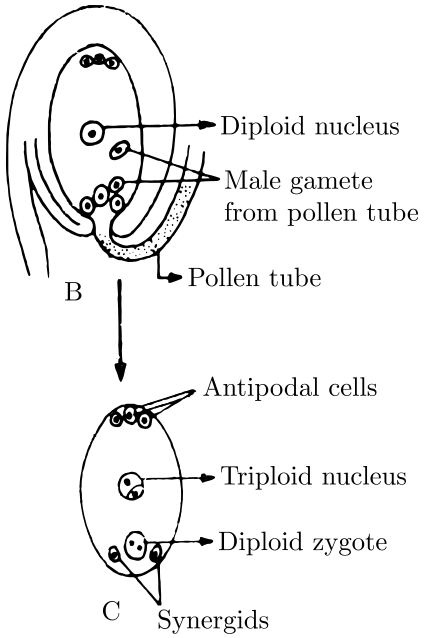

Fig Changes in the Embryosac

218. What do you mean by seed ? Describe the process for formation of a seed.

Ans : **OD 2013**

A seed is a small embryonic plant enclosed in a covering called the seed coat, usually with some stored food. It is the product of the ripened ovule of gymnosperm and angiosperm plants which forms after fertilization and some growth with in the mother-plant. The formation of the seed completes the process of reproduction in plants (started with the development of flowers and pollination), with the embryo developed from the zygote and the seed coat from the integuments of ovule.

The formation of seed starts with double fertilization in angiosperms and it involves the fusion of the egg and sperm nuclei into a zygote. It is followed by the fusion of the polar nuclei with a second sperm cell nucleus, thus forming a primary endosperm. Right after fertilization the zygote is mostly inactive but the primary endosperm divides rapidly to form the endosperm tissue. This tissue becomes the food that the young plant will consume until the roots have developed after germination, or it develops into a hard seed coat.

The seed, which is an embryo with two points of growth, one of which forms the stems and the other the roots is enclosed in a seed coat with some food reserves. The new seeds is formed in plant structures called fruits.

219. Define cross-pollination. Write the various agencies of cross-pollination.

Ans : **COMP 2005**

The process of transfer of pollen grain from one flower to the stigma of another flower of same or different plant is called as cross pollination.

Agents for cross pollination: Various methods of cross pollination are as follows.

1. **Abiotic Agents :** It involves physical or non living agents like wind, water etc.
   (a) **Anemophily :** When flowers are pollinated by wind agency, the phenomenon is known as anemophily. Anemophilous flowers are small and inconspicuous with long and versatile stamens. e.g., Sugarcane, Maize, Wheat Bamboo, Grasses.
   (b) **Hydrophily :** When the pollination takes place through the agency of water, it is known as hydrophily e.g. Potamogeton, Myriophyllum or Entomophilous e.g., Alisma, Lotus.
2. **Biotic Agents :** It includes animals of different types like insects, birds, bats etc.
   (a) **Entomophily :** When pollination is brought about by the agency of insects, it is known as entomophily or insect pollination. About 80% pollination occurs by insects like months, beetles, butterflies, wasp, etc. All the flowers pollinated by insects are brightly coloured, have a sweet smell and produce nectar. Entomophilous flowers produce a small amount of pollen which has a spinous and sticky exine due to presence of pollenkitt. The stigmas of such flowers are long rough and sticky. e.g. Yucca, Ficus etc.
   (b) **Ornithophily :** When flowers are pollinated by birds, the phenomenon is known as ornitophily. The most common bird pollinators are Sun bird, Humming bird, Crow, Bulbul, Parrot Mynah, etc. Flowers are brightly coloured and produce plenty of nectar and large quantities of pollen. Humming bird pollinates while hovering over the flowers and sucking nectar. The bird can derive about half of its body weight of nectar in a single day. The nectar is chiefy made of sugars and provides a sweet drink to the bird.
   (c) **Chiropterophily :** It is a mode of pollination performed by bats. The flowers they visit are large, dull-coloured and have a strong scent. Chiropterophilous flowers produce abudant pollen grains. These flowers secrete more nectar than

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ornithophilous flowers and open at night emit a good fragrance e.g. Kadam tree.

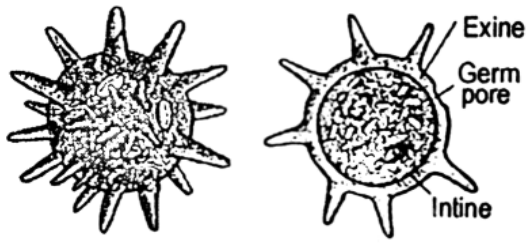
(d) **Malacophily :** Pollination by slugs and snails is called malacophily. e.g. Chrysanthemum, lemna.

220. Draw a diagram of a male gametophyte of an angisperm. Label any four parts. Why is sporopollenin considered the most resistant organic material?

Or

Describe the structure of 3-celled pollen grain of an angiosperm.

Ans : **SQP 2013, FOREIGN 2014**



(a) (b)

Fig Structure of mature pollen grain (a) Surface view, (b) Sectional view

Or

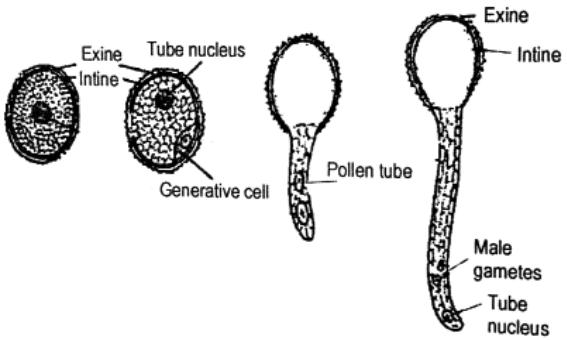


Fig Mature pollen grain and development of male gametophyte

The pollen grains are preserved as fossils due to the presence of sporopollenin. The exine consists of most resistant organic material because it can withstand high temperatures. It can also withstand the strong acids as well as the alkalis.

221. Differentiate between geitonogamy and xenogamy in plants. Which one between the two will lead to inbreeding depression and why?

Ans : **COMP 2020**

The difference between Geitonogamy and Xenogamy are as follows :

	Geitonogamy	**Xenogamy**
1.	It is transfer to pollens from the anther to the stigma of another flower of the same plant."	This is defined as the transfer of pollens from the anther to the stigma of a different plant.
2.	It is similar to autogamy functionally since it includes a pollinating agent or agency. The pollen grains come from the same plant whose flowers are to be pollinated.	In this type of pollination, the pollen grains are genetically different that fall upon the stigma of another plant's flowers.

Geitonogamy would lead to inbreeding depression since the pollens come from the same plant.

222. Pollination is an important phenomenon in the life cycle of a flowering plant. Describe the agencies responsible for this.

Ans : **OD 2013, DELHI 2015, SQP 2016**

The transference of pollen grain from anthers to the stigma of a flower is defined as **pollination**. There are two types of pollination:

1. **Self pollination** or **Autogamy**.
2. **Cross-pollination** or **Geitonogamy**.
   (a) **Autogamy:** The pollen from the anther is transferred to stigma of the same flower. **Example:** Wheat, rice and pea.
   (b) **Cross-pollination:** It is the transference of pollen from the anther of a flower to the stigma of another flower. It is also called **allogamy** and is generally found in unisexual as well as bisexual flowers.

The Agencies of cross-pollination :

	Agency of pollination	**Type of pollination**
1.	**Biotic Agents:**	
	1. Birds	Ornithophily
	2. Insects	Entomophily
	3. Animals	Zoophily
	4. Snails	Malacophily
	4. Bats	Chiropterophily
	6. Ants	Myrmicophily
2.	**Abiotic Agents:**	
	1. Water	Hydrophily
	2. Wind	Anemophily

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Ornithophily: Pollination by birds is known as Ornithophily. Bird pollinated flowers produce nectar.
Example: Red silk cotton, Bottle brush, Bignonia, etc.
Entomophily: Pollination by insects is known as entomophily. The flowers produce nectar and are brightly coloured to attract insects.
Example: Salvia and Euphorbia.
Zoophily: Pollination by animals including man is called zoophily. e.g., Wheat, maize, rice, etc. are artificially cross-pollinated by the breeders.

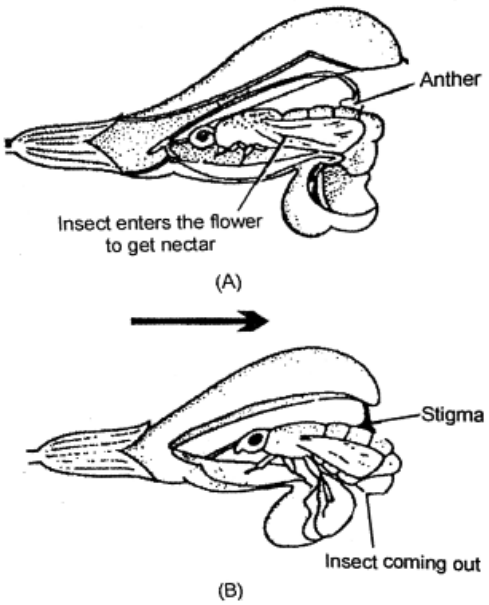

Fig Pollination in Salvia by Insects

223. How are seeds advantageous to flowering plants?

Ans : FOREIGN 2007, COMP 2018

The Seeds are Advantageous to the Flowering Plants:

1. As some reproductive process e.g., pollination etc. are independent of water, the formation of the seeds is more dependable.
2. The seeds have better adaptive strategies for the dispersal to new places/habitats and finally helpful to colonise far and wide.
3. The seeds have enough food to nourish the young seedlings.
4. The seed coat is hard enough to give protection to young embryo in seed.
5. They are source of variations since they are formed as a result of sexual reproduction.

224. Describe the structure of a monocotyledonous seed.

Ans : FOREIGN 2009, COMP 2015, OD 2020

It is one seeded fruit. It has only one cotyledon. Monocot seeds are mostly endospermic. The seed coat is membranous but fused to the fruit wall; hence called a grain/fruit. The main part of it is the endosperm (it stores food). It remains separated from embryo by aleurone layer. The small embryo lies in the groove of one end of endosperm. Embryo contains one shield like cotyledon called the scutellum, a short axis with radicle as well as the plumule. Plumule is covered by a sheath the coleoptile. But the radicle is covered by the coleorrhiza.
Orchid and Sagittaria seeds are non-endospermic seeds.

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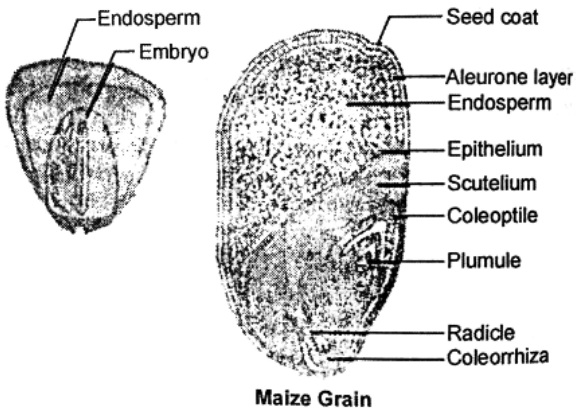


Fig Structure of seed : Monocot seed

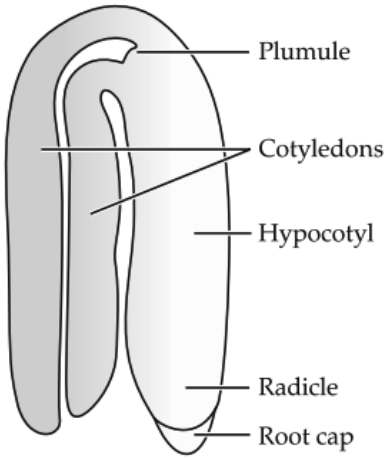
225. Why does endosperm development precede embryo development in angiosperm seeds? State the role of endosperm in mature albuminous seeds and Describe with the help of three labelled diagrams the different embryonic stages that include mature embryo of dicot plants.

Ans : DELHI 2012, SQP 2016

1. **Endosperm Development Proceeds Embryo Development :** Primary endosperm cell is divided repeatedly forming a triploidy (3 N) **endosperm tissue**. The tissue cells are filled with reserve food for nourishment of embryo that is developing. The PEN may undergo many division to form it.
2. **Development of Embryo in Typical Dicot Plant :** The fertilized egg divides into **basal suspensor cell (hypobasal cell)** and **terminal embryo cell (epibasal cell)** by a transverse wall. Further division take place and the epibasal cell divides separately to form a row of 4-8 cells. The terminal cell is divided to

form a cluster of cells called proembryo. So, the proembryo is formed. The hypobasal cell and other cells divide and form suspensor. The terminal cell divide and forms haustorium. The lower most cell of suspensor is developed into the apex or radicle. The embryo cell divides and form B-celled embryo after two successive divisions. Further divisions into celled embryo form the embryo proper. Its terminal cells form plumule and cotyledons. Embryo and endosperm develop both. The integuments become hard.

3. **Mature Dicot Embryo :**



226. Draw a labelled longitudinal sectional view of albuminous 'seed'.

Ans : OD 2012

L.S. view of An Albuminous Seed: e.g., castor seed.

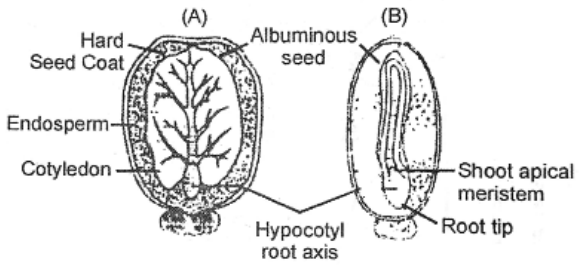


Fig Castor seed

It is an albuminous seed. It is also called endospermic seed.

227. Why is fertilization in Angiosperms referred to as "double fertilization"? Explain

Ans : DELHI 2007

Double Fertilisation: It means "the fusion of one male gamete with egg cell and other male gamete with the polar nuclei and the egg after fertilisation gives rise diploid zygote and polar nuclei give rise to triploidy endosperm".

In the flowering plants, there occurs **double fertilization**; so there occurs two fusion-one male gamete fuses to egg making a **diploid zygote** while the other fuses to 2 polar nuclei making the **triploidy endosperm** nucleus that forms endosperm.

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228. "Incompatibility is a natural barrier in the fusion of gametes". Justify the statement?

Ans : SQP 2010

1. **The Incompatibility:** It is considered as the most widespread as well as the effective devices to prevent or check inbreeding and outbreeding both.
2. **The "Pollen Pistil Interaction"** is a "dynamic process that involves pollen recognition that is followed by promotion or even the inhibition of the pollen grains".
   Justification: This acts as a natural barrier by **interaction of chemical substances** that are produced by style.

229. Show the development of monocot embryo by a series of figures only.

Ans : FOREIGN 2012

Development of Monocot Embryo :

A monocot embryo consists of only one cotyledon e.g., in grass family, cotyledon is called scutellum that lies towards one side of emrbyonal axis. At its lower end is coleorrhiza. The epicotyl is covered by coleoptile.

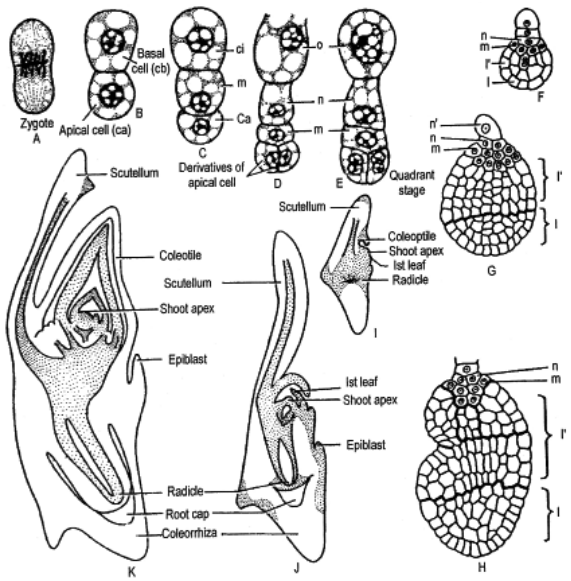

Fig Different stages of monocot embryo development

230. Explain the sequence of events in pollen-pistil interaction.

Ans : COMP 2015

Pollen-Pistil Reaction: It is a dynamic process. It involves pollen recognition by promotion or inhibition of the pollen. It can be studied under 2 heads:

1. **The Pollen is Compaitable:** The pollen grain germinates on stigma. The pollen tube grow through style. It enters the ovules and at least discharges two male gametes in one of the synergids. The angiosperms show double fertilization. Two fusion events occur in each emrbyo sac. (syngamy and triple fusion). Products of these fusions are (a) diploid zygote and (b) triploidy primary endosperm nucleus.
2. **The Pollen is Incompitable:** It may be natural or done by the breeders to get desired hybrids by crossing different genera and species of desirable traits to produce superior varieites ot plants or crops. It is done by emasculation and bagging.

231. Explain the process of microsporogenesis in angisopersm.

Or

1. How does microspore mother cell develop into mature pollen grain in angiosperms?
2. Describe the structure of a manure pollen grain and draw a labelled diagram of its two-celled stage.

Or

Describe in sequence the events that lead to the development of a 3-celled pollen grain from microspore mother cell in angiosperms.

Or

1. Name and explain the process of formation of male gametophyte in flowering plants.
2. Draw a labelled diagram of matured male gametophyte.

Or

Trace its development from sporogenous tissue in the anther.

Ans : COMP 2005

The pollen grains are produced in anther. A young anther consists of homogenous mass of undifferentiated meristematic cells surrounded by epidermis. During the development the anther becomes four lobed and each lobe is called as microsporangium. Each microsporangium have sporogenous cells which divide meiotically and increase in number before they function as microspore (pollen) mother cells. Each microspore mother cell divides meiotically and as a result four microspores are formed from each microspore mother cell. All the four microspores remain enclosed in a column wall. This four celled organisation is called tetrad. Later on, they mature as pollens.

Mature pollen grain is 2-celled-one is vegetative cell and the other is generative cell. In some species of angiosperms generative cell divides to form two male gametes hence pollen grains are shed at three-celled stage.

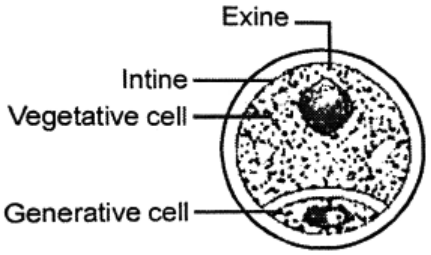

Fig Sectional view of mature pollen grain of an angiosperms

232. Give reasons why:

1. most zygotes in angiosperms divide only after certain amount of endosperm is formed.
2. groundnut seeds are exalbuminous and castor seeds are albuminous.
3. Micropyle remains as a small pore in the seed coat of a seed.
4. integuments of an ovule harden and the water content is highly reduced, as the seed matures.
5. apple and cashew are not called true fruits.

Ans : OD 2005

1. The **endosperm development** precedes the embryo development. The endosperm provides nourishment to the development embryo. So this is an adaptation to give assured nutrition to the embryo for its development.
2. The **groundnut seeds** are **exalbuminous** since they process no residual endosperm because it is fully absorbed during development of embryo.

   The Castor seeds are called albuminous since they retain a part of endosperm as it is not fully used up during embryo development.
3. **Micropyle:** It remains as a small pore in the seed coat of a seed to facilitate the entry of oxygen O_2 and water (H_2O) into the seed during the process of germination of a seed.

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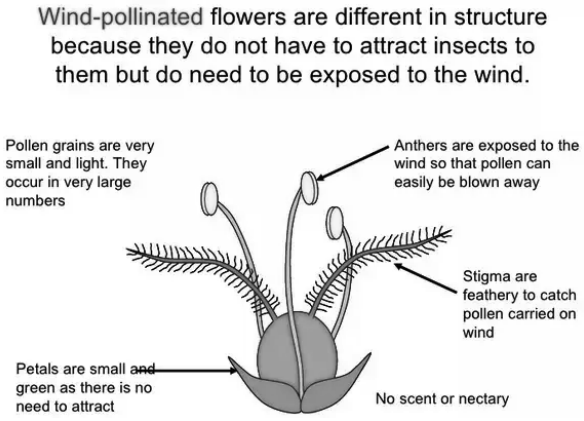
4. **Integuments of an ovule harden,** water content is highly reduced when the seed matures. The metabolic activities slow down as embryo enters in dormant stage.
5. **Apple and cashew are** not called true fruits but they are false fruits as the thalamus takes part in fruit formation. A true fruit develops from ovary only.

CASE BASED QUESTIONS

233. The process of wind pollination is also termed as anemophily and is considered to be the most common amongst the abiotic pollination. The flowers that are pollinated by wind are small, colourless, inconspicuous and nectarless in nature. Such flowers have well exposed anthers and are commonly found as in grasses, bamboo, coconut etc.



(i) Why the anthers in such flowers are well exposed ?

(ii) State the characteristic nature of pollen grains of these flowers.

(iii) What type of stigma are found in flowers pollinated by wind.

Ans :

(i) This is done for the easy dispersal of the pollen grains from one flower to another for pollination.

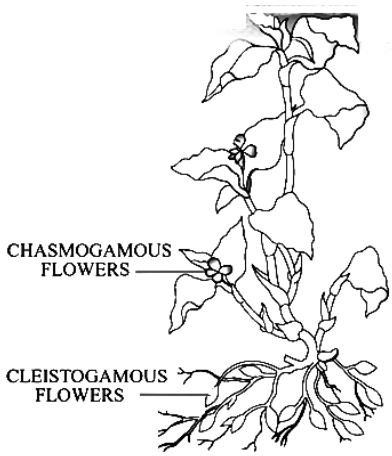
(ii) The pollen grains are small, light, weightless, dry, dusty, non-sticky and even winged in nature.

(iii) The stigmas is large, hairy, branched to catch the air borne pollen grains.

234. Pollination is the act of transferring pollen grains from male anther of a flower to the female stigma. The goal of every living organism including plants is to create offspring for the next generation. One of the ways that plants can produce offspring is by making seeds which then germinate to produce new plants. Two types of flowers with their pollination seen in plants are chasmogamy and cleistogamy. Chasmogamous flowers have strikingly coloured petals and nectar guides/ nectaries in contrast to cleistogamous flowers which are minute bud-like.

(i) Why Cleistogamous flowers are strictly autogamous ?

(ii) Identify the figure below and write any two feature that relates to it.



(iii) Given any two advantages of Cleistogamy are:

Ans :

(i) The Cleistogamous flowers are strictly autogamous because they are closed flowers and the anther and stigma lies close to each other self ensuring pollination.

(ii) The above given figure is of plant bearing chasmogamous flower. Out of which chasmogamous is autogamous in nature while in cleistogamous sex organs are exposed.

(iii) Two advantages of Cleistogamy are :
(i) They are not dependent on pollinators.
(ii) No chances of cross pollination.

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CHAPTER 2

HUMAN REPRODUCTION

SUMMARY

1. HUMAN REPRODUCTION

Humans exhibit sexual dimorphism. It is a major trend of breeding. Sexual reproduction involves the fusion of nuclei from two different gametes to form the zygote. In humans, the sexes are separate. There is distinct sexual dimorphism due to the secondary sexual features in both sexes e.g., beard in male and breasts in female.

1.1 Sexual Reproduction

In it two parents are required. Each parent is capable of producing gametes called spermatozoa and ova. Human beings are sexually reproducing and viviparous.

1.2 Developmental Periods

These are pre-natal embryonic and post-natal (post embryonic period). Major reproductive events include gametogenesis, fetilization, cleavage, implantation, placentation, gastrulation and organogenesis as well as child birth.

2. HUMAN MALE AND FEMALE REPRODUCTIVE SYSTEMS

In human beings, reproduction occurs sexually due to the separation of sexes. Human male reproductive system consists of pair of testes, genital ducts, several accessory glands and the penis. Female reproductive system consists of two ovaries, two oviducts (uterine tubes), the uterus, a vagina along with the external genitalia, accessory genital glands and the mammary glands.

2.1 Secondary Sexual Features

The mammary glands are well developed in the females and rudimentary in males. The females do not develop beard and moustache but males do. The voice in females is pitched higher than in males.

2.2 Events in Human Reproduction

The major event is formation of gametes (gametogenesis). The spermatozoa and ova are two types of gametes. Oogenesis is called the formation of ova. Formation of gametes starts at puberty that starts at the puberty age of 9-11 in girls and 11-13 in boys. It begins early in females. Cyclic changes occur in females.

2.3 Gametogenesis Formation of Gametes

It is needed in sexual reproduction. One primary spermatocyte gives rise to 4 functional sperms while one primary oocyte gives rise to a single functional ovum. The spermatozoa develop form PGO's. Ova also originate form the primodial germ cells i.e., PGO's.

2.4 Spermatogenesis

Sperms are formed by this process. In the process of spermiogenesis a spermatid differentiates into structurally complex spermatozoan/sperm. Temperature of scrotum is congenial for sperm production because it is lower by 2°C than the normal body temperature (37°C) the endocrines control spermatogenesis. ABP plays role in it. Sertoli cells produce inhibin.

2.5 Oogenesis

It takes place in ovaries. It occurs under the influence of LH, estrogenes and other steroid hormones. High level of estrogens inhibit GnRH secretion.

3. MENSTRUAL CYCLE

In human female the reproductive cycle is called menstrual cycle and it is of 28 days duration.

The ovulation occurs at mid cycle. FSH and estrogens play key roles in it. Some changes in organs are:

1. **Ovaries :** During first phase ovary enlarges and comes to the surface of ovary. The process

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of ova formation starts. An ovarian follicle grows for about 14 days secreting oestrogen. The ovum is then discharged.

2. **Uterus :** The inner walls of the uterus are highly vascularised and muscular is nature and known as a endometrium. This wall takes active part in menstrual cycle because it breaks down due to the lack of progesterone as a result bleeding occurs and later on it is repaired. In the follicular phase uterus enlarges its size.
3. **Fallopian tube :** Fallopian tube are lying on either side of uterus. They transport ovum from ovaries to the uterus. The wall of the fallopian tube gets thickened and its cilia and their movements are increased. It helps conveying the ovum down to the uterus.

4. CORPUS LUTEUM

Corpus luteum produces hormones. It is degenerated into corpus albicans, a white body when level of progesterone falls.

5. FERTILIZATION

The fertilization is the fusion of two dissimilar types of gametes called spermatozoa and ova. Fertilization in humans is internal and takes place in the fallopian tube.

Acrosome in sperm head releases enzyme which helps the sperm to penetrate through the follicle cells and non-cellular layer around the ovum.

6. IMPLANTATION

The blastocyst, after one week of fertilization embeds into uterine wall to establish the pregnancy.

7. EMBRYONIC DEVELOPMENT

In sexually reproducing metazoans, the embryonic development starts with the fertilization of an egg cell by a sperm.

The fertilized egg is a specific 'blue print' for the future of development. The fertilized ovum passes through the specific stages of development to attain the adult organisation.

8. CLEAVAGE

Cleavage divisions result in complete division of the zygote and the subsequent daughter cells. The resulting structure is known as blastocyst. Cleavage is holoblastic in humans.

9. CLEAVAGE DIVISION

Cleavage division do not bring any appreciable increases the mass of protoplasm in the developing embryo, but there is a marked increase in the chromosomal DNA contents of its cells.

10. GASTRULATION

Gastrulation is the visible dynamic event of cell movements in the blastocyst or blastodermic vesicle.

Cells of blastocyst differentiate into three germ layers - ectoderm, mesoderm and endoderm. The establishment of germ layers starts the phase of differentiation and specialization.

By three months, all systems of the baby are formed. The development of the foetus, primarily a matter of growth and minor structural modification.

11. PREGNANCY AND PLACENTA FORMATION

The pregnancy is established after the implantation. The endometrium undergoes huge changes and is termed as decidua. Its tissues are differentiated into decidua basilis, decidua capsularis and the decidua parietalis. In gastrulation morphogenetic movements occur. The embryo passes neurulation and enters into the organogenesis phase. Extra embryonic membranes appear. Then placenta is formed. It acts as endocrine organs also. Progesterone is called pregnancy hormone. Relaxin is produced by ovary. Placenta also produces hcG, hPL and estrogens also.

NODIA

12. PARTURITION (CHILD BIRTH) AND LACTATION

Gestation period is average duration of pregnancy in humans. It is about 9 months. As the time of birth and for a few days after, the mother's breasts contain a fluid called colostrum which is rich in calories and protein. It has antibodies. They provide passive immunity for the new born infant. Three or four days after delivery, the breasts start to secrete milk. The onset of labour is called parturition. Many integrated hormonal control and act.

OBJECTIVE QUESTIONS

1. The total number of eggs produced by a healthy human female during life time:
(a) 4000 (b) 400
(c) 40 (d) 365

Ans : OD 2024, 2018
Human females produce a limited number of eggs during their life time. They ovulate approximately 400 egg during her reproductive period.
Thus (b) is correct option.

2. Sertoli cells are found in:
(a) Testis (b) Uterus
(c) Ovary (d) Liver

Ans : OD 2017
Sertoli cells are found in testis of human male. These are the nurse cells that provide nourishment to the developing sperm cells.
Thus (a) is correct option.

3. Acrosome is a part of:
(a) Head of human sperm
(b) Middle part of human sperm
(c) Primary oocyte
(d) Blastocyst

Ans : OD 2017
Acrosome is a cap like structure derived from golgi apparatus, present on anterior head region of human sperm. It contains digestive enzymes like hyaluronidase acrosin etc. that help to dissolve egg memberanes during fertilisation.
Thus (a) is correct option.

4. Chromosome number in human being (male) is:
(a) $44 + XX$ (b) $44 + XY$
(c) $46 + XY$ (d) $46 + XX$

Ans : OD 2017
Normal humans contain 22 pairs of autosomal chromosomes and one pair of sex chromosomes (allosomes). Normal karyotype for female is 46, XX while for males its is 46, XY.
Thus (c) is correct option.

5. What is the number of chromosomes present in human gametes ?
(a) 21 (b) 23
(c) 44 (d) 46

Ans : OD 2015
Human gametes are haploid (n) cells. They contain only 23 chromosomes. While, zygote is a diploid structure that has 46 chromosomes.
Thus (b) is correct option.

6. Regulation of spermatogenesis is done by
(a) oestrogen (b) L.H.
(c) androgen (d) none of these

Ans : OD 2015
Out of the given options luteinizing hormone (LH) play a role in regulation of spermatogenesis. It stimulates leydlig cells to produce testosterone. It acts synergistically with FSH.
Thus (b) is correct option.

7. The process of formation of gametes is called:
(a) Gametogenesis (b) Cytokinesis
(c) Sporogenesis (d) Meiocytes

Ans : OD 2012
The process of formation of gametes, by meiotic division in germinal cells present in gonads is called as gametogenesis. It results in for nation of sperms in males and ova (egg) in females.
Thus (a) is correct option.

8. Middle piece of mammalian sperm contains:
(a) nucleus (b) vacuole
(c) mitochondria (d) centriole

Ans : OD 2009
Middle piece of mammalian sperm cell possess mitochondria. It provides energy for the motility of sperm during fertilization.
Thus (c) is correct option.

9. Prostate gland secretion helps in formation of
(a) larva (b) semen
(c) cocoon (d) none of these

Ans : COMP 2010
The prostate gland is a chestnut shaped gland which lies at the base of bladder and surrounds the first part of the urethra. This gland secretes a slightly alkaline fluid which forms the important component of semen. The fluid constitutes the major portion of seminal fluid which carries sperm and sperms move freely in this fluid. Prostate gland secretion contains lipids, small amount of citric acid, HCO_3^- ions and a few enzymes. They activate and provides nutrition to sperms an neutralise the acidity of urine which may kill the sperms. They form about 30% part of semen.
Thus (b) is correct option.

10. Immediately after ovulation, the mammalian egg is covered by a membrane called as
(a) chorion (b) corona radiata
(c) zona pellucida (d) none of these

Ans : OD 2012
Immediately after ovulation, mammalian eggs are

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covered by vitelline membrane.
Thus (d) is correct option.

11. The extra-embryonic membranes of mammalian embryo are derived from
(a) trophoblast (b) follicle cells
(c) inner cell mass (d) formative cells

Ans : DELHI 2015

Trophoblast in mammalian embryo produces extra embryonic membranes which provide protection and nourishment to foetus. These are of 4 types - chorion, amnion, allantois and yolk sac embryonic membranes.
Thus (a) is correct option.

12. Acrosome of sperm is formed by
(a) nucleus (b) golgi bodies
(c) lysosome (d) E.R.

Ans : SQP 2017

Acrosome of sperm is formed Golgi bodies and contains hydrolysing enzymes for sperm penetration.
Thus (b) is correct option.

13. Cumulus covers
(a) ovary (b) ovum
(c) embryo (d) sperm

Ans : FOREIGN 2022

Cumulus covers the ovum. The ovum at the matured condition s has a massy cloud formed with a flat base and rounded outlines piled up like a mountain. A granulosa cell is a somatic cell found closely associated with the developing female gamete (oocyte or egg) in the ovary of mammals. Granulosa cells form a single flattened layer around the oocyte in the primordial ovarian follicle and later in follicle development they advance to form a multi layered cumulus surrounding the oocyte.
Thus (b) is correct option.

14. Cessation of menstrual cycle in women is called
(a) menopause (b) lactation
(c) ovulation (d) parturition

Ans : COMP 2021

Menopause is the period when ovulation and menstrual cycle stop in human females. The period of menopause is between 45-55 years.
Thus (a) is correct option.

15. Both corpus luteum and macula lutea are
(a) found in human ovaries.
(b) a source of hormones.
(c) characterized by a yellow colour.
(d) contributory in maintaining pregnancy.

Ans : OD 2007

Corpus luteum is the fluid filled yellow body in the ovary and macula lutea is the yellow spot present in the eyes.
Thus (c) is correct option.

16. The early human embryo distinctly possesses
(a) gills (b) gill slits
(c) external ear (pinna) (d) eyebrows

Ans : DELHI 2009

Thus (c) is correct option.

17. The phase of menstrual cycle in humans that lasts for 7-8 days, is
(a) follicular phase (b) ovulatory phase
(c) luteal phase (d) menstruation

Ans : SQP 2013

In menstrual cycle, menstrual phase lasts for 4 days, proliferating/ovulating phase for about 10 days and secretory phase for 14 days.
Thus (b) is correct option.

18. Women who consumed the drug thalidomide for relief from vomiting during early months of pregnancy gave birth to children with
(a) no spleen
(b) hare-lip
(c) extra fingers and toes
(d) under developed limbs

Ans : FOREIGN 2011

Woman who took the drug thalidomide in early pregnancy gave birth to children with severe birth defects such as missing or shortened limbs.
Thus (d) is correct option.

19. In humans, what is the ratio of the number of gametes produced from one male primary sex cell to the number of gametes produced from one female primary sex cell?
(a) 1 : 3 (b) 1 : 4
(c) 3 : 1 (d) 4 : 1

Ans : COMP 2017

Four visible sperm cells are produced form one primary sex cell, whereby only one viable egg cell is produced, due to the unequal division of cytoplasm and the formation of polar bodies,which wither and die.
Thus (d) is correct option.

NODIA

20. Corpus luteum is a mass of cells found in
(a) brain (b) ovary
(c) pancreas (d) spleen

Ans : OD 2012

Corpus luteum is a yellow coloured mass of cells found in ovary. Corpus luteum secretes progesterone hormone, which is essential for maintaining pregnancy and therefore also called as "Pregnancy hormone."
Thus (b) is correct option.

21. Cells of leydig are found in
(a) Testes of frog (b) Testes of rabbit
(c) Kidney of frog (d) Kidney of rabbit

Ans : DELHI 2008

leydig cells are the characteristic of mammalian testis. They produce hormone, testosterone meant for development of secondary sexual characters in males.
Thus (b) is correct option.

22. Which of the following organ is differentiated first during development?
(a) Heart (b) Skin
(c) Brain (d) Netural tube

Ans : SQP 2006

In human beings, after one month of pregnancy, the embryo's heart is formed. By the end of second month of pregnancy limbs and digits are developed. By the end of 12 weeks (first trimester) most of the major organ systems are formed.
Thus (a) is correct option.

23. The correct sequence of spermatogenetic stages leading to the formation of sperms in a mature human testis is :
(a) spermatogonia-spermatid-spermatocyte-sperms
(b) spermatocyte-spermaogonia-spermatid-sperms
(c) spermatogonia-spermatocyte-spermatid-sperms
(d) spermatid-spermatocyte-spermatogonia-sperms

Ans : FOREIGN 2007

Spermato geuesis is the process by which haploid spermatozoa develop from germ cells in testis. This Process starts with mitotic division. Mitotic division produces stem cells and spermatoytes. Spermatoaytes divides into two equal haploit Spermaticls by milosis II. This spermatids develop into mature spermatozoa by the process of speneiogenesis. This is called sperm cells.
Thus (c) is correct option.

24. Ejaculation of human male contains about 200-300 million sperms, of which for normal fertility ..... % sperms must have normal shape ans size and at least ..... % must show energetic motility.
(a) 40, 60 (b) 50, 50
(c) 60, 40 (d) 30, 70

Ans : COMP 2014

Ejaculation of human male contains about 200-300 million sperms of which for normal fertility 60% sperms must have normal shape and size and at lest 40% must show energetic motility.
Thus (c) is correct option.

25. The enlarged end of penis is covered by a loose fold of skin is called
(a) glans penis (b) foreskin
(c) hymen (d) urethral meatus

Ans : OD 2018

Foreskin is a double-layered fold of smooth muscle tissue, blood vessels, neurons, skin, and mucous membrane that covers and protects the glans penis and the urinary meatus when the penis is to erect. The foreskin is mobile, fairly stretchable,and acts as a natural lubricant.
Thus (b) is correct option.

26. Which of the following is a transporting tube leading form the bladder to which brings urine outside the body via penis?
(a) Ureter (b) Epididymis
(c) Ejaculatory duct (d) Urethra meatus

Ans : DELHI 2023

The urethra originates from the urinary bladder and extends through the penis to its external opening called urethral meatus.
Thus (d) is correct option.

27. Vasa efferentia are the ductules leading from
(a) epididymis to urethra.
(b) vas deferens to epididymis.
(c) rete testis to vas deferens.
(d) testicular lobules to rete testis.

Ans : SQP 2016

The vasa efferentia leave the testis and open into epididymis located along the posterior surface of each testis. The epididymis leads to vas deferens. Or we can say that the vas efferentia or efferent ducts connect the rete testis with the initial section of the epididymis.
Thus (c) is correct option.

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28. A sac shaped like an upside down pear with a thick lining and muscles in the pelvic area where a fertilized egg or zygote comes to grow into a baby is called .....
(a) oviduct (b) uterus
(c) vagina (d) vulva

Ans : **FOREIGN 2018**

The uterus is a female reproductive organ located between the bladder and the rectum, in the pelvic area. The main purpose of the uterus is to nourish a fetus prior to birth. In menstruating females, the ovaries release eggs which travel via the fallopian tubes to the uterus.
Thus (b) is correct option.

29. Which of the following is a finger like structure and lies at the upper junction of the two labia minora above the urethral opening?
(a) Clitoris
(b) Oviduct
(c) Ampulla
(d) Chorionic villi

Ans : **COMP 2017**

Clitoris is a small, sensitive, erectile part of the female genitals at the anterior end of the vulva. It is homologous with the penis.
Thus (a) is correct option.

30. Which of the following produces sperms in spermatogenesis?
(a) Sertoli cells.
(b) Interstitial cells.
(c) Primary spermatocytes.
(d) Immature male germs cells

Ans : **OD 2014**

Immature male germs cells (also called as spermatogonia) produce sperms in the process of spermatogenesis. spermatogonium proliferate continuously by mitotic divisions around the outer edge of the seminiferous tubules, next to the basal lamina. Some of these cells stop of these cells stop proliferation and differentiate into primary spermatocytes. After they proceed through the first meiotic division, two secondary spermatocytes are produced. The two secondary spermatocytes undergo the second meiotic division to form four haploid spermatids. These spermatids differentiate morphologically into sperm by nuclear condensation, ejection of the cytoplasm and formation of the acrosome and flagellum.
Thus (d) is correct option.

31. In the process of spermatogenesis, first maturation division is called .....
(a) mitotic division
(b) reduction division
(c) amitotic division
(d) none of these

Ans : **DELHI 2012**

The immature male germ cells or primary spermatocyte duplicates its DNA and subsequently undergoes meiosis -I which is a reductional division to produce two haploid secondary spermatocytes.
Thus (b) is correct option.

32. Spermatids are transformed into sperm by a process called .....
(a) spermiation (b) implantation
(c) insemination (d) spermiogenesis

Ans : **SQP 2010**

Spermiogenesis is the final stage of spermatogenesis, which is involves the maturation of spermatids and, its transformation into mature, motile spermatozoa.
Thus (d) is correct option.

33. In humans, male germs cells differentiate into ..... at the end of first meiotic division.
(a) spermatid
(b) spermatogonium
(c) secondary spermatocyte
(d) primary spermatocyte

Ans : **FOREIGN 2008**

Each Primary spermatocyte duplicates its DNA and subsequently undergoes meiosis-I to produce two equal, haploid secondary spermatocytes. Each of the two secondary spermatocytes. Each of the two secondary spermatocytes further undergoes meiosis-II to produce two haploid spermatids. Therefore, total four equal, haploid spermatids are producted after second meiotic division.
Thus (c) is correct option.

34. Increased secretion of which hormone start the process of sperm formation at the time of puberty?
(a) GH (b) TSH
(c) PRL (d) GnRH

Ans : **COMP 2006**

Gonadotropin-releasing hormone (GnRH) is released from the anterior pituitary. GnRH activity is very low during childhood and is activated at puberty or adolescence. At the puberty increased secretion of GnRH start the process of sperm formation.
Thus (d) is correct option.

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35. After birth, colostrum is released from mammary glands which is rich in
(a) fat and low in proteins
(b) proteins and low in fat
(c) proteins, antibodies and low in fat
(d) proteins, fat and low in antibodies

Ans : **OD 2009**

Colostrum is the first form of milk produced by mother colostrum coutaius properin and antibiotic to protect the new born.
Thus (c) is correct option.

36. Which of the following hormone maintains the function of male sex accessory gland and ducts?
(a) Estrogen
(b) Androgen
(c) Progesterone
(d) Luteinizing hormone

Ans : **OD 2024, 2005**

Androgen is a male sex hormone which is responsible for proper functioning of male sex accessory glands and ducts.
Thus (b) is correct option.

37. Semen is a constituent of seminal plasma with .....
(a) ovum (b) sperm
(c) zygote (d) follicle

Ans : **DELHI 2011**

Semen or seminal fluid, is an alkaline fluid that contains spermatozoa embedded in seminal plasma. Semen is ejaculated by male reproductive system during orgasm.
Thus (b) is correct option.

38. Which of the following stage of oogenesis forms a membrane called zona pellucida surrounding it?
(a) Oogonia
(b) Polar body
(c) Corpus luteum
(d) Secondary oocytes

Ans : **SQP 2015**

The zona pellucida is a glycoprotein thick non-cellular membrane surrounding the plasma membrane of an oocyte or secondary oocytes.
Thus (d) is correct option.

39. By which process sperms released from the seminiferous tubules?
(a) Spermiation (b) Insemination
(c) Spermatogenesis (d) Spermiogenesis

Ans : **FOREIGN 2009**

The mature spermatozoa are released form the protective sertoli cells into the lumen of the seminiferous tubule and a process called spermiation then takes place, which removes the remaining unnecessary cytoplasm and organelles.
Thus (a) is correct option.

40. Which of the following contains a fluid filled cavity called antrum?
(a) Primary spermatocyte
(b) Primary follicle of ovary
(c) Tertiary follicle of ovary
(d) Secondary spermatocyte

Ans : **COMP 2007**

In biology, antrum is a general term for a cavity or chamber, which may have specific meaning in reference to certain organs or sites in the body. Tertiary follicle of ovary contains a fluid filled cavity called antrum and a secondary oocyte ready for ovulation.
Thus (c) is correct option.

41. Menstruation is triggered by a sudden decline in the amount of hormone secreted by corpus luteum. Identify the hormone.
(a) Luteinizing hormone
(b) Follicle stimulaing hormone
(c) Progesterone
(d) Estrogen

Ans : **OD 2017**

The corpus luteum secretes large amounts of progesterone which is essential for maintenance of the endometrium and the pregnancy but its decrease in secretion triggers the menstrual cycle.
Thus (c) is correct option.

42. Level of which hormones are at their highest during the luteal phase (second half of the cycle) of the menstrual cycle?
(a) Estrogen
(b) Progesterone
(c) Luteinizing hormone
(d) Follicular stimulating hormone

Ans : **DELHI 2020**

The ovulation (ovulatory phase) is followed by the luteal phase (latter phase of the menstrual cycle) during which the remaining parts of the Graafian follicle transforms the corpus luteum, which produces progesterone. So progesterone is highest at luteal phase.
Thus (c) is correct option.

NODIA

43. Which phase of menstrual cycle is also called proliferative phase?
(a) Luteal (b) Ovulatory
(c) Follicular (d) Menstruation

Ans : SQP 2011

The menstrual phase is followed by the follicular phase. During this phase, the primary follicles in the ovary grow to become a fully mature Graafian follicle and simultaneously the endometrium of uterus regenerates through proliferation.
Thus (c) is correct option.

44. Which phase of menstrual cycle is also called secretory phase?
(a) Luteal (b) Ovulatory
(c) Follicular (d) Menstruation

Ans : FOREIGN 2013

Luteal phase is also called as the secretory phase of menstruation cycle. The luteal phase begins with the formation of the corpus luteum and ends in either pregnancy or luteolysis. The main hormone associated with this stage is progesterone, which is significantly higher during the luteal phase than other phases of the cycle.
Thus (a) is correct option.

45. Which of the following indicates pregnancy?
(a) Lack of menstruation
(b) Occurrence of menstrual flow.
(c) When released ovum is not fertilized.
(d) When Graafian follicle matures and endometrium regenerates through proliferation.

Ans : COMP 2015

During pregnancy all events of the menstrual cycle stop and there is no menstruation.
Thus (a) is correct option.

46. When semen is released by the penis into the vagina during copulation, then it is called .....
(a) ovulation (b) insemination
(c) menstruation (d) gametogenesis

Ans : OD 2007

The process of insemination is the release of semen containing male gametes, the sperms into the female reproductive tract during coitus.
Thus (b) is correct option.

47. At the time of implantation, the human embryo is called .....
(a) zygote (b) blastocysts
(c) embryo (d) foetus

Ans : DELHI 2009

During human embryogenesis, the blastocyst arises form the morula in the uterus, after 5 days of fertilization. The early embryo undergoes cell differentiation and structural changes to becomes the blastocyst. It is then prepared for implantation into the uterine wall 6 days after fertilization. Implantation marks the end of the germinal stage and the beginning of the embryonic stage of development.
Thus (b) is correct option.

48. Fusion of haploid nucleus of sperm and that of ovum lead to the formation of .....
(a) zygote (b) blastocysts
(c) embryo (d) foetus

Ans : SQP 2014

In sexual reproduction in organisms, when the two nuclei of male and female gametes fuse together the immediate cell which is formed is called the zygote. The zygote goes on to become an embryo and later stages of development.
Thus (a) is correct option.

49. Which of the following differentiate into embryo?
(a) Morula (b) Zyote
(c) Trophoblast (d) Inner cell mass

Ans : FOREIGN 2011

In the blastocyst, the blastomeres are arranged into an outer layer called trophoblast and an inner group of cells attached to trophoblast called the inner cell mass. The trophoblast layer than gets attached to the endometrium and the inner cell mass gets differentiated as the embryo.
Thus (d) is correct option.

50. Trophoblast and inner cell mass are the arrangements of blastomeres as outer and inner layers respectively in .....
(a) zygote
(b) morula
(c) placenta
(d) blastocysts

Ans : COMP 2012

The blastocysts is a thin-walled hollow structure in early embryonic development. It possesses an inner cell mass (ICM) which subsequently forms the embryo. The outer layer of the blastocyst consists of cells collectively called the trophoblast. This layer surrounds the inner cell mass and a fluid-filled cavity known as the blastocoel. The trophoblast gives rise to the placenta.
Thus (d) is correct option.

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51. Which layer of blastocysts gets attached to the endometrium?
(a) Trophoblast (b) Inner cell mass
(c) Umbilical cord (d) Both (a) and (c)

Ans : OD 2018

The outer wall of the blastocyst i.e., the trophoblast gets attached to the endometrium of the uterus during implantation.
Thus (a) is correct option.

52. Finger like projection called chorionic villi, appear on the ..... after the implantation.
(a) ampulla (b) trophoblast
(c) infundibulum (d) inner cell mass

Ans : DELHI 2006

After implantation, the trophoblast develops finger like projections on its outside known called as chorionic villi, which are surrounded by the uterine tissue and maternal blood.
Thus (b) is correct option.

53. The placenta is formed from the ..... of the embryo and the ..... of the mother.
(a) uterus, trophoblast
(b) chorion, endometrium
(c) endometrium, chorion
(d) inner cell mass, endometrium

Ans : SQP 2011

The chorionic villi and the endometrium become interdigitated with each other and together form a structural and functional unit between developing embryo (foetus) and maternal body called placenta.
Thus (b) is correct option.

54. Placenta acts as an
(a) Embryo (b) Corpus luteum
(c) Exocrine gland (d) Endocrine tissue

Ans : OD 2005

Apart from being a nourishing medium for the developing foetus, the placenta also acts as an endocrine tissue, producing hormones like human chorionic gonadotropin (hCG), human placental lactogen (hPL), estrogens, progestogens, etc.
Thus (d) is correct option.

55. Primary germ layers are
(a) ectoderm and inner cell mass only.
(b) trophoblast, ectoderm and mesoderm.
(c) endoderm and mesoderm only.
(d) ectoderm, endoderm and mesoderm.

Ans : FOREIGN 2010, COMP 2015, OD 2012

Primary germ layers are ectoderm, endoderm and mesoderm. Many animals are primarily triploblastic, as endoderm (inner) and ectoderm (outer) interact to porduce a third germ layer, called mesoderm (middle). Together, the three germ layers will give rise to every organ in the body, from skin and hair to the digestive tract.
Thus (d) is correct option.

56. Which of the following hormone acts on uterine muscle and causes its stronger contraction?
(a) Relaxin (b) Estrogen
(c) Oxytocin (d) Progesterone

Ans : DELHI 2012, SQP 2018, FOREIGN 2020

Oxytocin acts on the uterine muscle and causes its strong contractions, which inturn further stimulates the secretion of oxytocin making a kind of feedback loop. Thus, the resultant stimulatory reflex between the uterine contraction and oxytocin secretion continues resulting in stronger and stronger contractions.
Thus (c) is correct option.

57. Colostrum
(a) is a hormone essential for milk secretion.
(b) can be synthesized by the newborn infant but not by a foetus.
(c) stimulates further secretion of oxytocin for uterine contraction.
(d) is a source of antibodies essential to develop resistance against diseases in new born babies.

Ans : COMP 2022

Whatever milk is produced during the initial few days of location is called colostrum. This contains several antibodies absolutely essential to develop resistance for the new-born babies.
Thus (d) is correct option.

58. Secretion of milk from the mammary gland towards the end of the pregnancy is called .....
(a) loctation
(b) parturition
(c) fertilization
(d) implantation

Ans : OD 2015

The mammary glands of the female undergo differentiation during pregnancy and starts producing milk towards the end of pregnancy by the process called lactation.
Thus (a) is correct option.

NODIA

59. Two types of cells present in the lining of seminiferous tubules are ..... and .....
(a) leydig cells, sertoli cells.
(b) male germ cells, sertoli cells.
(c) spermatogonium, spermatids.
(d) primary oocyte, leydig cells.

Ans : **DELHI 2006**

Male germ cells and sertoli cells are two types of cells present in the lining of seminiferous tubules. Male germ cells give rise to male gamete of an organism that reproduces sexually. A sertoli cell (a kind of sustentacular cell) is a nurse cell of the testicles whose main function is to nourish the developing sperm cells through the stages of spermatogenesis. Sertoli cells also act as phagocytes, consuming the residual cytoplasm during spermatogenesis.
Thus (b) is correct option.

60. First polar body is formed during the formation of ..... and completion of ..... meiotic division.
(a) Primary oocytes, II
(b) Secondary oocytes, I
(c) Secondary spermatocytes, II
(d) Primary spermatocytes, I

Ans : **SQP 2012**

First polar body is formed during the formation of secondary oocytes and completion of I^{st} meiotic division. In humans, the secondary oocytes are produced when the primary oocytes complete meiosis I.
Thus (b) is correct option.

61. Second meiotic division in secondary oocyte results in the formation of
(a) first polar body and a diploid ovum.
(b) first polar body and a haploid ovum.
(c) second polar body and a diploid ovum.
(d) second polar body and a haploid ovum.

Ans : **FOREIGN 2015**

Second meiotic division in secondary oocyte results in the formation of a second polar body and a haploid ovum (ootid).
Thus (d) is correct option.

62. In human female, menopause is a stage in which
(a) Oogenesis starts at puberty.
(b) menstruation starts at puberty.
(c) corpus luteum starts secreting progesterone for maintaining pregnancy.
(d) menstruation stops at the age of 50 years and reproductive capacity is arrested.

Ans : **COMP 2018**

In human beings, menstrual cycles ceases around 50 years of age; that is termed as menopause.
Thus (d) is correct option.

63. Which of the following process induces the completion of the meiotic division of secondary oocyte?
(a) Parturition (b) Implantation
(c) Fertilization (d) Gametogenesis

Ans : **OD 2007**

Fertilization (the fusion of male and female gametes) induces the completion of the meiotic division of secondary oocyte. The secondary Oocytes will be arrested at the stage of metaphase II of meiosis II until fertilization takes place. Thus, when a sperm cell fertilization the ovum, the secondary oocyte rapidly completes the remaining stages of meiosis II, giving rise to an ootid and an ovum, which the sperm cell unites with.
Thus (c) is correct option.

64. ..... is a sticky white or yellow fluid secreted by the breasts during the second half of pregnancy and for a few days after birth, before breast milk comes in.
(a) Placenta (b) Colostrum
(c) Egg yolk (d) Blood cells

Ans : **DELHI 2008**

The milk produced during the initial few days of lactation is called colostrum which is somewhat sticky and yellowish or greyish white in colour.
Thus (b) is correct option.

65. Which gland releases a small amount of fluid just prior to ejaculation to decreases acidity in the urethra caused by urine?
(a) Prostate
(b) Glans penis
(c) Seminal vesicle
(d) Bulbourethral gland

Ans : **SQP 2014**

Bulbourethral gland also called as Cowper's gland, is one of two small exocrine glands in the male reproductive system. This gland releases a small amount of fluid just prior to ejaculation to decrease the acidity in the urethra. Bulbourethral gland are homologous to Bartholin's glands present in females.
Thus (d) is correct option.

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66. By the end of how many weeks, major organ system are formed during the embryonic development?
(a) 4 weeks (b) 8 weeks
(c) 12 weeks (d) 24 weeks

Ans : FOREIGN 2012

By the end of 12 weeks (first trimester), most of the major organ systems are formed, for example, the limbs and external genital organs are well-developed.
Thus (c) is correct option.

67. Which of the following induces foetal ejection reflex?
(a) Initiation of lactation
(b) Fully developed foetus and placenta
(c) Expulsion of the baby out of the uterus.
(d) Transport of embryo in the fallopian tube

Ans : COMP 2011

Fully developed foetus and the placenta induce foetal ejection reflex. Foetal ejection reflex is also called mild uterine contraction.
Thus (b) is correct option.

68. Identify the structure on the basic of the given statement which surrounds the primary sex organ of male reproductive system.
"It is responsible for maintaining the low temperature by about $2-2.5^{\circ}C$ from normal body temperature to mature sperm."
(a) Penis (b) Scrotum
(c) Ureter (d) Urethra

Ans : OD 2016

Scrotum is a part of the external male genitalia located behind and underneath the penis. It is the small muscular sac that contains and protects the testicles, blood vessels, and part of the spermatic cord. The scrotum protects the testicles (or testes, the primary male sex organ) from temperature changes. In order to insure normal sperm production, the scrotum keeps the testes at a temperature slightly cooler than the rest of the body by contracting or expanding.
Thus (b) is correct option.

69. Which of the following is not a paired structure in male?
(a) Urethra (b) Vas deferens
(c) Epididymis (d) Ejaculatory duct

Ans : DELHI 2020

Urethra is not a paired structure in male. The urethra is a tube that connects the urinary bladder to the urinary meatus for the removal of fluids from the body. In male, the urethra travels through the penis and carries semen as well as urine and in female, the urethra is shorter and emerges at the female external urethral orifice above the vaginal opening.
Thus (a) is correct option.

70. Blastomeres are daughter cells formed in the process of
(a) Cleavage, when zygote undergoes mitotic division.
(b) fertilization, when sperm enters in the cytoplasm of ovum.
(c) implantation, when blastocysts attached to the uterine endometrium.
(d) gametogenesis, when male and female gametes are produced by testis and ovary respectively.

Ans : SQP 2012

Blastomeres are a type of cell produced by cleavage (cell division) of the zygote after fertilization and are an essential part of blastula formation.
Thus (a) is correct option.

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ASSERTION AND REASON

DIRECTION : Each of these questions contains as Assertion following by Reason. Read them carefully and answer the question on the basis of following options. You have to select the one that best describes the two statements.

71. **Assertion :** During fertilization only head of spermatozoa enters egg.
Reason : If several spermatozoa hit the egg at same time, all can enter the egg.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : FOREIGN 2007

Fertilization is the fusion of male and female gametes to form zygote. During fertilization only head of the sperm enters egg. After that polyspermy is avoided by fertilization membrane.
Thus (c) is correct option.

72. **Assertion :** In morula stage, cells divide without increase in size.
Reason : Zona pellucida remains undivided till

cleavage is complete.

(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) The Assertion is correct but Reason is incorrect.

(d) Both the Assertion and Reason are incorrect.

Ans : **COMP 2010**

Morula involves cheavage of cells till 32 cell stage is formed. It is still surrounded by Zona pellucida.
Thus (a) is correct option.

73. **Assertion :** Death is one of the important regulatory process on earth.
Reason : It avoids over-crowding caused by continuous reproduction.

(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) The Assertion is correct but Reason is incorrect.

(d) Both the Assertion and Reason are incorrect.

Ans : **OD 2013**

Death is the ultimate goal of every organism. This is caused by the wear and tear of organs which constitute the body of a living being.
Thus (a) is correct option.

74. **Assertion :** Old age is not an illness. It is a continuation of life with decreasing capacity for adaptation.
Reason : Cessation of mitosis is a normal genetically programmed event.

(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) The Assertion is correct but Reason is incorrect.

(d) Both the Assertion and Reason are incorrect.

Ans : **OD 2005**

Old age is the progressive deterioration in the structure and functioning of cells, tissues and organs and cessation of immune system.
Thus (c) is correct option.

75. **Assertion :** Senescence is the time when age associated defects are manifested.
Reason : Certain genes may be undergoing sequential switching on and off during one's life.

(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) The Assertion is correct but Reason is incorrect.

(d) Both the Assertion and Reason are incorrect.

Ans : **DELHI 2010**

According to programmed senescence theory of ageing, ageing is a result of switching on and off of certain genes. B and T-lymphocytes undergo programmed cell death called apoptosis.
Thus (a) is correct option.

76. **Assertion :** Corpus is not remnant of penis in females.
Reason : It also has high blood supply and erectile tissue.

(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) The Assertion is correct but Reason is incorrect.

(d) Both the Assertion and Reason are incorrect.

Ans : **SQP 2015**

In female, Graafian follicle forms corpus luteum after ovulation. The cells of corpus luteum are called luteal cells. The cytoplasm of luteal cells have yellow granules called lutein which secrete the hormone progesterone to maintain pregnancy if fertilization takes place. In the absence of fertilization, corpus luteum degenerates and forms corpus albicans and there is decrease in progesterone level as well.
Thus (b) is correct option.

77. **Assertion :** Clitoris is not remnant of penis in females.
Reason : It also has high blood supply and erectile tissue.

(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) The Assertion is correct but Reason is incorrect.

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(d) Both the Assertion and Reason are incorrect.

Ans : FOREIGN 2009

Clitoris is a female reproductive organ. It is homologous to penis of males. It is not remnant of penis. It is devoid of erectile tissue and high blood supply as in penis, penis is the copulatory organ of males.
Thus (c) is correct option.

78. Assertion : Mammalian ova produces hyaluronidase.
Reason : The eggs of mammal are microlocithal and telolecithal.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : COMP 2015

Hyaluronidase, a hydrolytic enzyme is an acrosomal content in mamalian sperm. It helps at the time of fertilization during the penetration of the sperm into the ovum. Based on the amount of yolk mammalian eggs are alecithal means egg without yolk. Microlecithal eggs contain very little yolk. Microlecithal eggs contain very little yolk e.g., sea urchin, starfish. On the basis of distribution of yolk telolecithal eggs are those eggs in which the yolk is concentrated towards the vegetal pole and cytoplasm and nucleus lie near the animal pole, e.g., birds and reptiles.
Thus (d) is correct option.

79. Assertion : Head of sperm consists of acrosome and mitochondria.
Reason : Acrosome contains spiral row of mitochondria.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : OD 2017

Head of a sperm has acrosome but the spiral row of mitochondria are present in the mid (connecting) piece of the sperm.
Thus (c) is correct option.

80. Assertion : Females have less stature than males after puberty.
Reason : This happens because of the presence of hCG in the blood of females.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : DELHI 2009

Males have more stature than females because of the action of male sex hormone-testosterone which is secreted by testis in males. Body starts secreting testosterone from the age of puberty. Its secretion is under the influence of Luteinizing Hormone (LH) of the anterior lobe of pituitary gland. Testosterone controls the development of secondary sexual characters in males like hoarseness of voice, development of facial hairs, bone growth, calcium retention, closing of epiphysial cartilage. The total quantity of bone matrix increases. The pelvic outlet is narrowed and lengthened. The strength of the pelvic bones increases to carry more loads. That is why, males have more stature than females after puberty when this hormone is present in the blood. hCG (Human Chorionic Gonadotropin) is the hormone secreted by human placenta during pregnancy. hCG enlarges the corpus luteum in the mother's ovary and stimulates it to secrete progesterone.
Thus (c) is correct option.

NODIA

81. Assertion : Testicular lobules are the compartments present in testis.
Reason : These lobules are involved in the process of fertilization.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : SQP 2008

Testicular lobules are the compartments present in the testes, are not involved in the process of fertilization as whole. Fusion of male and female gametes is called fertilization.
Thus (d) is correct option.

82. **Assertion :** Interstitial cell is present in the region outside the seminiferous tubule called interstitial spaces.
Reason : Interstitial cells provide nutrition to the sertoli cells.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : FOREIGN 2006
Leydig cells, also known as interstitial cells, are found adjacent to the seminiferous tubules in the testicle. They produce testosterone in the presence of luterinizing hormone (LH).
Thus (c) is correct option.

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VERY SHORT ANSWER QUESTIONS

83. How many spermatozoa are formed from one secondary spermatocyte?

Ans : OD 2005
From one secondary spermatocyte only 4 spermatozoa are formed.

84. Where does the first cleavage division of zygote take place?

Ans : COMP 2012
First cleavage division of zygote occurs in isthmus of oviduct when it moves towards uterus.

85. Where do the signals for parturition originate from in humans?

Ans : OD 2016
Signals for parturition originate in the fully developed uterus and placenta in humans that induce foetal ejection reflex.

86. Why is it important to feed the new born babies on colostrum?

Ans : DELHI 2018
The colostrum contains many antibodies that are necessary for developing resistance for the new born babies.

87. Placental acts as an endocrine tissue. Justify.

Ans : SQP 2020
Placenta produces many hormones such as progesterone and HPL (human placental lactogen). These hormones are necessary for foetal growth and maintenance of pregnancy.

NODIA

88. Explain the role of ovarian hormones in inducing changes in the uterus during menstrual cycle.

Ans : FOREIGN 2023
Role of ovarian hormones during menstrual cycle for changes in uterus : It is done by changes in the levels of pituitary and ovarian hormones amount.

89. What triggers release of oxytocin at the time of parturition?

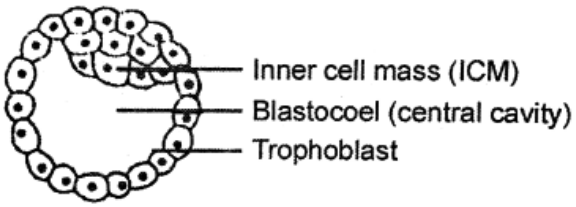
Ans : OD 2005
Oxytocin and Parturition : Foetal ejection reflex triggers the release of oxytocin from natural pituitary gland at child birth.

90. When does oogenesis begin?

Ans : COMP 2007
Oogenesis is initiated during foetal life.

91. Draw a labelled diagram of a human blastocyst.

Ans : OD 2009
Human Blastocyst :



92. Give the name of structures by which testes are suspended in the scrotum.

Ans : DELHI 2021
Spermatic cords.

93. Name the cells that nourish the germ cells in the testes. Where are these cells located in the testes?

Ans : All India 2013
Sertoli cells.
They are found on the inner lining of seminiferous tubule.

94. List the different parts of human oviduct through which the ovum travels till it meets the sperm for fertilisation.

Ans : DELHI 2014
The different parts of human female oviduct through which the ovum travels till it gets fertilised are
Fimbriae → Infundibulum → Ampulla → Isthmus

95. State the function of fimbriae.

Ans : **OD 2014**

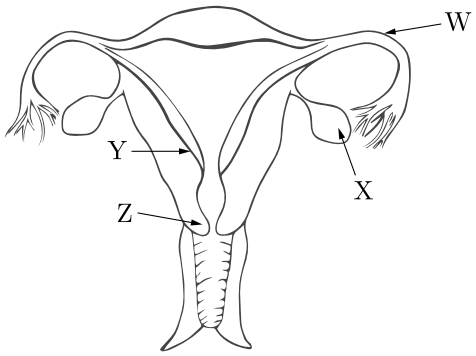
Fimbriae are finger-like projections at the opening of Fallopian tubes that help in the collection of ovum after ovulation.

96. What is the role of cervix in the human female reproductive system?

Ans : **SQP 2015**

Cervix helps in regulating the passage of sperms into the female uterus. It also forms the birth canal along with vagina to facilitate parturition.

97. The diagram shows the female reproductive system. Where do fertilisation and implantation occur?



Ans : **SQP 2011**

Fertilisation takes place in Fallopian tube (W) and implantation takes place in uterus (Y).

98. Name the glandular layer of human uterus.

Ans : **FOREIGN 2016**

Endometrium

99. Which layer of uterus undergoes cyclic changes during the menstrual cycle?

Ans : **COMP 2018**

Endometrium

100. Are male and female gametes haploid or diploid?

Ans : **COMP 2016**

Male and female gametes are haploid.

101. Spermatids possess haploid chromosome number. Explain.

Ans : **OD 2020**

Spermatids are produced by meiosis during spermatogenesis. Thus, they possess haploid number of chromosomes.

102. Name the process of release of spermatozoa from Sertoli cells into cavity of seminiferous tubule.

Ans : **DELHI 2013**

Spermiation.

103. Name the hormones which maintain accessory ducts in males.

Ans : **SQP 2008**

Androgens.

104. State the stage at which oogonia reach their maximum number.

Ans : **FOREIGN 2006**

Before birth at five months of foetal life, oogonia reach their maximum number.

105. List the changes the primary oocyte undergoes in the tertiary follicular stage in human embryo.

Ans : **FOREIGN 2011**

In human embryo, the primary oocyte grows in size, completes meiosis-I and forms a larger cell, the secondary oocyte and a smaller cell, the first polar body.

106. When are polar bodies formed in female ovary?

Ans : **COMP 2012**

During the production of secondary oocyte and ovum.

107. Menstrual cycle ceases during pregnancy. Is it true/false? Explain.

Ans : **DELHI 2011**

True, the high levels of progesterone and oestrogens during pregnancy suppress the gonadotropins, which is required for the development of new follicles. Therefore, a new cycle cannot be initiated.

108. When does ovulation occur?

Ans : **OD 2010**

Middle of cycle (14th day).

109. Give the name of the hormone which is secreted by corpus luteum.

Ans : **DELHI 2016**

Progesterone.

110. What do you call the layer of cells forming the outer wall of the blastocyst?

Ans : **SQP 2019**

Blastoimeres.

111. How does the sperm penetrate through the zona pellucida in human ovum?

Ans : **DELHI 2013**

The sperm penetrates through zona pellucida with the help of secretions from acrosome

112. Name the thin clear coat surrounding mammalian egg.

Ans : **FOREIGN 2009**

Zona pellucida

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113. State the function of trophoblast in human embryo.

Ans : **OD 2005**

Trophoblast forms chorionic villi, which become part of the placenta.

114. What stimulates pituitary to release the hormone responsible for parturition? Give the name of hormone.

Ans : **All India 2011**

The signal from the fully developed foetus and placenta or the foetal-ejection reflex induces mild uterine contractions. The hormone released during this phase is oxytocin.
B-Uterus.

115. How does colostrum provide initial protection against diseases to newborn infants? Give one reason.

Ans : **COMP 2012**

Colostrum contains necessary antibodies (IgA and IgG) that provide protection against diseases to newborn infants.

116. Name the muscular layer of human uterus.

Ans : **OD 2018**

Middle myometrium

117. How many ova will be produced by one fully grown primary oocyte?

Ans : **DELHI 2020**

One ova is produced by one fully grown primary oocyte.

118. State the functions of acrosome.

Ans : **SQP 2008**

Acrosome contains hydrolytic enzymes used to penetrate the egg during fertilisation.

119. Sperms have a tail whereas egg does not, why?

Ans : **FOREIGN 2006**

Sperms swim by vibrating their tail in the fluid while eggs do not require it.

120. How many primary follicles are left in each ovary at puberty?

Ans : **DELHI 2005**

60,000 - 80,000

121. What is the function of umbilical cord?

Ans : **COMP 2013**

Placenta is connected to embryo through umbilical cord and helps in transport of substance to and from the embryo.

122. Name the important mammary gland secretion that provides resistance to a newborn.

Ans : **OD 2008**

Colostrum

SHORT ANSWER QUESTIONS

123. Draw a neat and well labelled diagram of transverse section of human ovary.

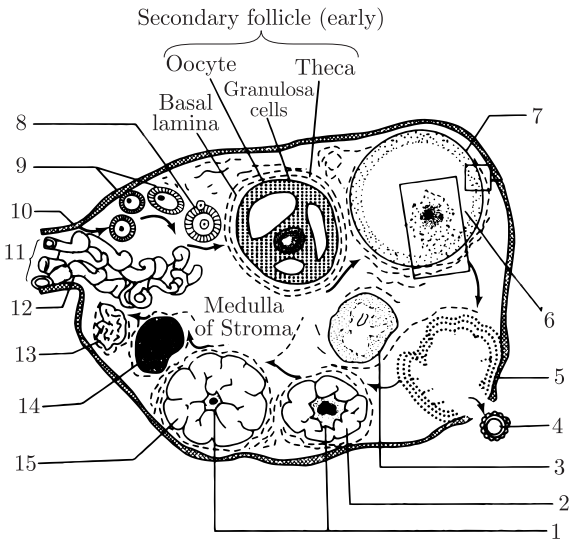
Or

Draw well labelled diagram of Transverse Section (T.S.) of human female ovary showing different stages of follicles.

Or

Draw well labelled diagram of T.S. human ovary showing various follicles.

Ans : **FOREIGN 2018, DELHI 2014, COMP 2016**



1. Blood clot (corpus haemorrhagicum)
2. Young corpus luteum
3. Atretic follicle
4. Released ovum
5. Ruptured follicle
6. Antrum with oestrogen rich follicular fluid
7. Graafian follicle (secondary follicle-mature)
8. Primary follicle
9. Primordial follicles
10. Germinal epithelium
11. Meso-varian
12. Blood vessels
13. Corpus albicans
14. Regressing corpus luteum
15. Mature corpus luteum

NODIA

124. Explain the role of any two accessory glands in human male reproductive system.

Ans : **OD 2015**

Two Accessory glands in Human Male Reproductive system :

(a) The male accessory glands are paired seminal vesicles. Prostate gland as well as paired bulbourethral glands. Secretions of these glands make seminal plasma. The seminal plasma contains fructose, calcium plus some enzymes.

(b) The secretions of bulbourethral glands help in the lubrication of male copulatory organ called the penis.

125. Differentiate between spermatogenesis and oogenesis.

Ans : **OD 2017**

The difference between spermatogenesis and oogenesis are as follows :

	Spermatogenesis	Oogenesis
1	Four spermatids are formed from one primary spermatocyte.	Only one ovum is formed from one primary oocyte.
2	Equal cytoplasmic divisions during meotic I and meiotic II and no formation of polar bodies.	Unequal cytoplasmic division during meiotic I and meiotic II and hence formation of polar bodies.
3	All stages are completed and sperms are formed in the testes only.	The secondary oocyte is released from ovary and final second meiotic division occurs in the fallopian tube just before fertilisation.
4	Spermatid undergoes spermiogenesis to get transformed into a sperm.	No such stage after the formation of ovum takes place.

126. Differentiate oestrus cycle and menstrual cycle.

Ans : **OD 2015**

The difference between oestrus cycle and menstrual cycle are as follows :

Menstrual Cycle	Oestrus Cycle
Occurs in primates.	Occurs in non-primate mammals.
There is bleeding due to broken endometrium which passes out in menstrual flow.	There is no bleeding and broken down endometrium gets absorbed.
There are no changes in the sex urge of female.	There are cyclic changes in the sex urge of the female.
Copulation is possible at any time during the cycle.	Copulation is possible only when level of oestrogen increases in blood (called as heat period).

127. What is implantation? When does this process begin?

Ans : **OD 2014**

The term "implantation" is used to describe process of attachment and invasion of the uterus endometrium by the blastocyst in placental animals. In humans, this process begins at the end of week 1, with most successful human pregnancies the blastula implants 8 to 10 days after ovulation, and early pregnancy loss increases with later implantation. The implantation process continues through the second week of development.

128. What is the function of corpus luteum ?

Ans : **OD 2010**

The corpus luteum is a hormone-secreting gland that forms after a mature egg is released from an ovarian follicle. It is composed of granulosa- and theca lutein cells and primarily secretes the steroid hormone, progesterone. If the egg is not fertilized the corpus luteum will degenerate and form the corpus albicans.

129. Draw a labelled diagram of male reproductive system.

Ans : **DELHI 2019**

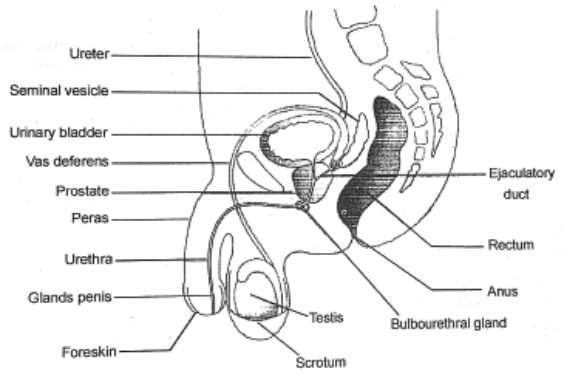


Fig Human male reproductive organs

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130. Draw a labelled diagram of female reproductive system.

Ans : **OD 2011**

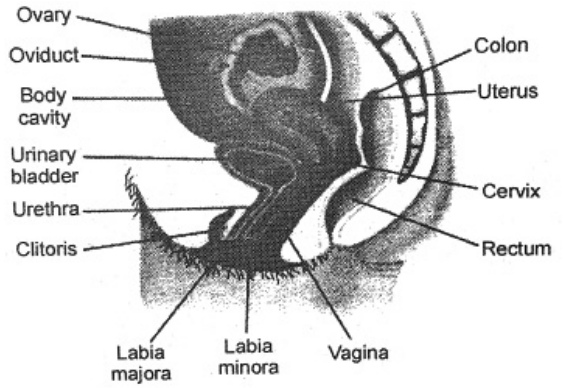


Fig Human female reproductive system

131. Write two major functions each of testis and ovary.

Ans : **COMP 2010**

	Name of organ	Functions	
1	Testis	1. 2.	It produces sperms, the male gametes which are haploid. Leydig cells of testis produce androgens like testo sterone.
2.	Ovary	1. 2.	It produces female gamete the ovum which is haploid. It secretes several steroid hormones called ovarian hormones.

132. Describe structure of a seminiferous tubule.

Ans : **SQP 2009**

One to three highly coiled seminiferous tubules are contained in testicular lobe. Each seminiferous tubule is lined on its inner side by 2 kinds of cells :

1. Spermatogonia (male germ cells) and
2. Sertoli cells (nutritive cells)

Male germ cells undergo meiotic division to form sperms. The sertoli cells serve for nutrition to the germ cells.

The part outside seminiferous tubules is interstitial space. This contains cells of Leydig or interstitial cells which synthesized and secrete androgens (testicular hormones).

133. What is spermatogenesis? Briefly describe the process of spermatogenesis.

Ans : **FOREIGN 2013**

Spermatozoa are formed by the process of spermatogenesis from the spermatogonia in the male gonad, testis. It takes place in three stages only. These are following:

1. Spermatocytogenesis,
2. Meiosis and
3. Spermiogenesis

In spermatocytogenesis, the spermatogonia divide by mitoiss cell division and produce successive generation of cells. These cells form spermatocytes. In meiosis, the primary spermatocyte undergoes meiosis I to produce two haploid (N) secondary spermatocytes. Each of these undergo meioisis II and forms two spermatids.

Spermiogenesis is the transformation of spermatids into the sperms. It involves the formation of acrosome, elongation of nucleus, the development of the flagellum as well as cytoplasmic substances and organelles.

134. Name the hormones involved in regulation of spermatogenesis.

Ans : **COMP 2006**

Spermatogenesis is regulated by testosterone secreted by cell of Leydig (interstitial cells), under control of FSH and testosterone, the sertoli cells produce ABP (Androgen Binding Protein). The sertoli cells produce inhibin that inhibits synthesis of FSH by pituitary gland. Release of LH or ICSH is under control of GnRH.

135. Define spermatogenesis and spermiation.

Ans : **OD 2007**

1. **Spermatogenesis :** It is the production of sperms, the male gametes from immature germ cells of testis. It begins at puberty.
2. **Spermiation :** The transformation of the spermatids into the sperms or spermatozoa is called spermiogenesis. After sprmiation, sperm heads are embedded into sertoli cells and are at last released from seminiferous tubules by a process known as the spermiation.

NODIA

136. What are the major components of seminal plasma?

Ans : **DELHI 2008**

Seminal Plasma is the secretion of male accessory glands (seminal vesicles bulbourethral glands). Seminal plasma is rich in calcium (Ca), fructose and some enzymes.

The secretion of Cowper's glands bulbo-urethral glands helps in the lubrication of penis of male.

137. What are the major functions of male accessory ducts and glands?

Or

Draw a labelled diagrammatic view of human male reproductive systems.

Ans : **SQP 2018**

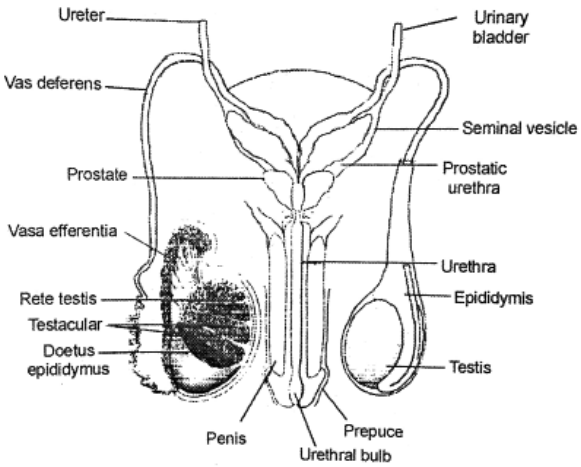
Male accessory Ducts and Glands : These include rete testis, vasa efferatia, epididymis, vas deferens etc.

Seminiferous tubules from testis open into vasa efferentia rete testis.

The vasa efferentia leave testis and open into epididymis

Epididymis leads into vas deferens. It loops over urinary bladder. It receives a duct from seminal vesicle which opens into urethra as ejaculatory duct.

Urethra originates from urinary bladder. It extends through the penis to its opening called urethral meatus. These ducts store and transport sperms from testis to outside urethra. The male accessory glands produce secretions that is seminal plasma.



Secretions of bulbourethral glands help in lubrication of penis in male human.

138. Write the functions of the following:

1. Endometrium,
2. Acrosome
3. Sperm tail
4. Fimbriae

Ans : **COMP 2014**

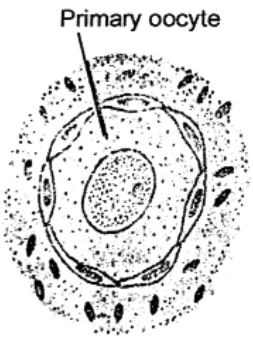
1. **Endometrium :** The wall of uterus consists of 3 layers of tissue - external perimetrium, middle myometrium and inner endometrium.

   Endometrium lines uterine cavity. It is a glandular layer. It undergoes cyclic changes during menstrual cycle.

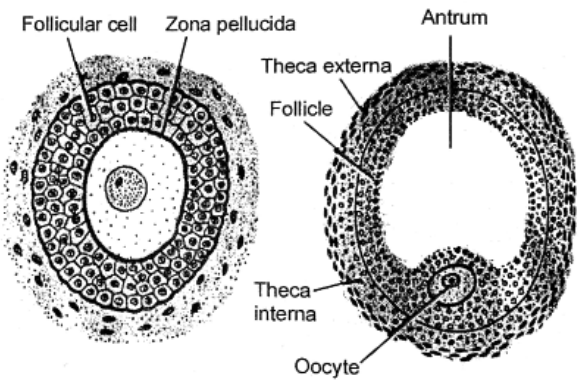
2. **Acrosome :** It is a compact structure located above the nucleus in the head of mammalian sperm. It is covered over by a double layered membrane. It forms a kind of head cap over the nucleus . Acrosome provides penetration of the sperm into ovum at the time of fertilization. It secretes some specific enzymes which dissolve the egg membranes at the point of entry of sperm into the egg.
3. **Sperm tail :** The human sperm possesses a tail and hence it is motile. The tail is long. The middle piece of sperm has mitochondria that produces energy for movement of the tail.
4. **Fimbriae :** Each fallopian tube is 10-12 cm in length. It extends from periphery of ovary to the uterus. The part close to the ovary is infundibulum; it is funnel shaped. The edges of this infundibulum has finger shaped projections. These are called fimbriae. Fimbriae help in collection of the ova after the process of ovulation.

139. Draw a labelled diagram of Graafian follicle.

Ans : **FOREIGN 2016**



(a)



(b) (c)

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140. What is parturition? Which hormones are involved in induction of parturition ?

Ans : **OD 2008**

The onset of labour is called parturition. Many integrated hormonal control and act. The first result of labour is the opening of the cervix. By continued powerful contractions, the amnion ruptures and the amniotic fluid (the "waters") flows out through the vagina. The baby follows its umbilical cord is being cut. The infant's lungs expand and it begins breathing. It needs a major switch over in the circulatory system. Blood flow through the umbilical cord, ductus arteriosus and foramen ovale ceases; the adult pattern of blood flow through the heart, aorta and pulmonary arteries begins. In some infants, the switch over is incomplete and blood flow through the pulmonary arteries is inadequate. Failure to synthesize enough nitric oxide is one cause. Shortly after the baby is born, the placenta along with remains of the umbilical cord called "afterbirth" are expelled out. The hormone relaxin helps in parturition.

141. In our society the women are often blamed for giving birth to daughters. Can you explain why this is not correct ?

Ans : **DELHI 2009**

It is wrong to blame women for giving birth to daughters. The sex chromosome pattern in human male is XY and that in the female human is XX. Male produces two kinds of gametes : half with X chromosome and half with Y chromosome. The female produces one type of gametes i.e., all have X chromosome.

After fusion of male and female gametes the zygote carry either XX or XY. XX zygote would be female and XY would develop into male child. So, the sex of baby is determined by father and not the mother.

Conclusion : The presence of X or Y chromosome in the sperms/male gametes determines the sex of the child in human beings.

142. A human female experiences two major changes, menarche and menopause during her life. Mention the significance of both the events.

Ans : **FOREIGN 2005**

Menarche represents the beginning of menstrual cycle which is an indication of attainment of sexual maturity. Menopause, on the other hand, refers to the cessation of menstruation which in turn means stoppage of gamete production i.e., it marks the end of reproductive/fertile life of the female.

143. Corpus luteum in pregnancy has a long life. However, if fertilisation does not take place, it remains active only for 10-12 days. Explain.

Ans : **COMP 2014**

This is because of a neural signal given by the maternal endometrium to its hypothalamus in presence of a zygote to sustain the gonadotropin (LH) secretion, so as to maintain the corpus luteum as long as the embryo remains there. In the absence of a zygote, therefore, the corpus luteum cannot be maintained longer.

144. What is foetal ejection reflex? Explain how it leads to parturition?

Ans : **DELHI 2018**

Foetal Ejection Reflex refers to "the reflex for induction of mild uterine contractions for child birth". It triggers the release of hormone oxytocin from the pituitary gland of mother that acts on uterus muscles; cause stronger contractions of uterine muscles; further secretion of oxytocin causes more contractions and baby is expelled from uterus out via birth canal.

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145. Why doctors recommend breast feeding during initial period of infant growth?

Ans : **SQP 2015**

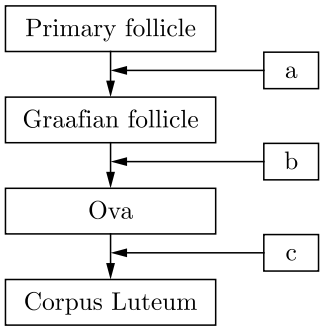
Breast feeding is recommended by doctors since the milk (colostrum) produced by mother contains many antibodies that are necessary to develop immunity and resistance to new born baby. It is essential to bring up a healthy child also.

146. What are the events that take place in the ovary and uterus during follicular phase of the menstrual cycle?

Ans : **FOREIGN 2011**

1. The primary follicle grows and becomes fully mature graafian follicle.
2. Secretion of estrogen hormone.
3. Endometrium of uterus regenerates through proliferation.

147. Given below is a flow chart showing ovarian changes during menstrual cycle. Fill in the space giving the name of the hormones responsible for the event shown.



Ans : **OD 2009**

a-FSH and estrogen;
b-LH;
c-progesterone.

148. How is Polyspermy prevented in humans?

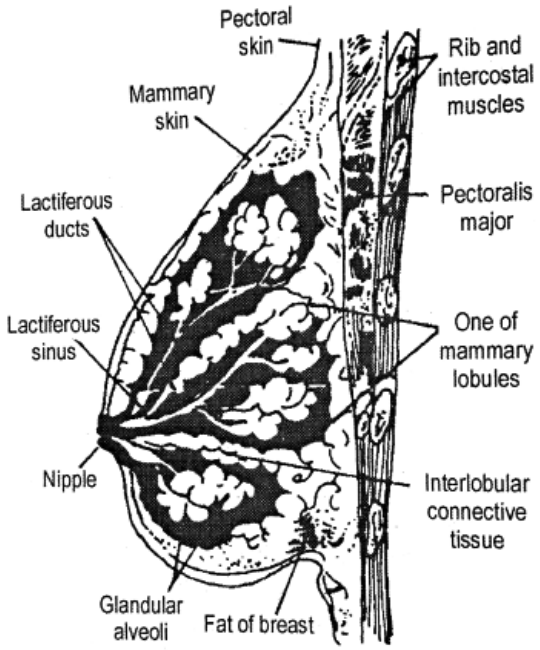
Ans : **DELHI 2010**

The mammalian ova is covered over by follicular cells, corona radiata, and zona pellucida. These prevent the entry of the sperm into the egg.
The sperm gains entry in the ovum when acrosome produces hyaluronidase to that acts on ground substance of follicle cells, zona lysin (acromin) and zona pellucida. The point of entry makes the animal pole of the egg and polar bodies are given from this point. The egg shows cortical reaction and zona reaction which makes egg impervious to any second sperm.

149. With a suitable diagram, describe the organisation of mammary gland.

Ans : **DELHI 2005**

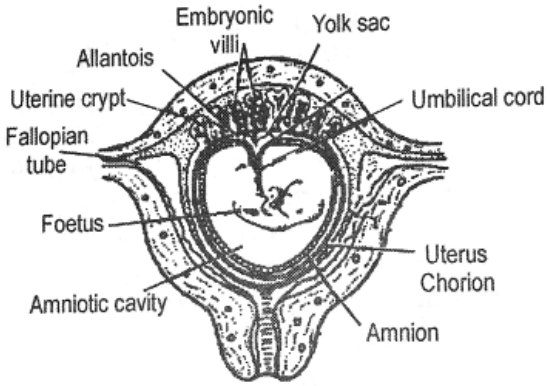
Each mammary gland of 15-25 lobules of the compound tubuloalveolar type. The lobules secrete milk to nourish the new born babies. Each lobe is separated from the other by dense connective and adipose tissue and represents a gland. From each lobe, excretory lactiferous ducts emerge independently in the nipple. It has 15-25 openings, (each about 0.5 mm in diameter). The histological structure of mammary glands varies greatly depending upon sex, age and physiological state of female.



150. Write the two main types of placenta. Draw a well labelled sketch also.

Ans : **FOREIGN 2008**

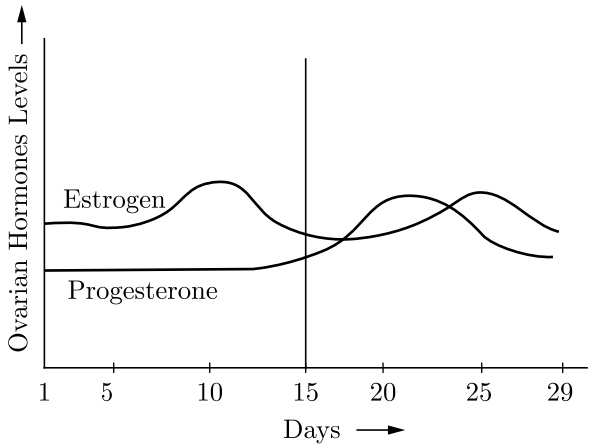
Mammalian placenta are mainly of two types :



1. Choriovitelline placenta e.g., Macropus .
2. Chorioallantioic placenta e.g., Dasyurus and eutherian mammals.

   In man, the placenta is metadiscoidal according to the distribution of villi on the chorion. Placenta acts as a protective organ.

151. Study the graph given below showing the levels of ovarian hormones during menstruation and correlate the uterine events that take place according to the hormonal levels on.



1. 6-15 days
2. 16-25 days
3. 26-28 days (if the ovum is not fertilized).

Ans : **COMP 2010**

1. Regeneration of Endometrium by proliferation of its cells.
2. The uterus gets highly vascularised. It is now ready of implantation of the embryo.
3. The break down and the disintegration of endometrium living of uterus lead to menstruation or the menstrual flow.

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152. Where are the Leydig cell present? What is their role in reproduction?

Ans : **SQP 2013**

They lie inside the interstitial spaces in seminiferous tubules; also called interstitial cells. They synthesize and secrete androgens; the testicular hormones. These hormones control secondary sex characteristics in the male humans.

153. Mention the target cells of luteinising hormone in human males and females. Explain the effect and the changes which the hormone induces in each case.

Ans : **OD 2015**

In males : the luteinising hormone acts on the Leydig cells. This stimulates the secretion and synthesis of Androgens. These Androgens initiate the process of spermatogenesis (the formation of sperms, the male gametes).

In female : Luteinising hormone with follicle stimulating hormone (FSH) in human females stimulate follicular development and secretion of estrogens by growing follicles. In Mid menstrual cycle, Luteinising hormone surge induces the rupture of graafian follicle as well as ovulation also.

154. Distinguish between-sperm and spermium.

Ans : **DELHI 2017**

Difference between Sperm and spermium are as follows :

	Sperm	**Spermium**
1.	It is formed after the spermiogenesis of spermatid.	It is formed after spermatogenesis of the spermatogonia.
2.	Specialized cell with distinct part like head, neck, middle piece and tail.	More or less structure of a generalized cell.

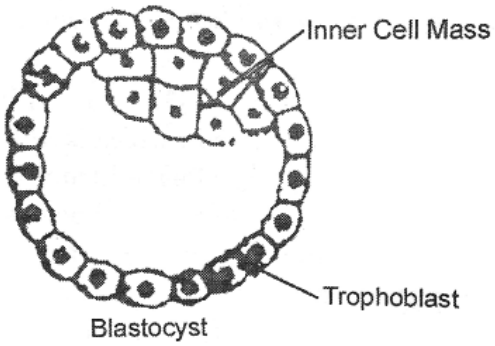
155. When and where do chorionic villi appear in humans? State their function.

Or

Name the stage of the human embryo that gets implanted in the uterus and draw its labelled diagram.

Ans : **FOREIGN 2005**

The blastocyst gets embedded in uterine endometridium (this is called implantation) and chorionic villi emerge on this trophoblast that unites to maternal body forming placenta.



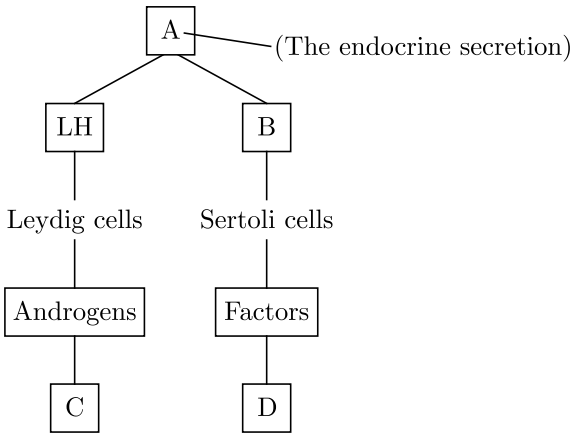
156. State the function of human female reproductive system.

Ans : **FOREIGN 2005**

The human female reproductive system performs many functions:

1. Oogenesis (origin or production of eggs),
2. Reception of sperm during copulation,
3. Provide an environment conductive to fertilization and
4. Supplying nutrition or nourishment to the baby, both at pre-natal and post-natal stages.

157. Identify A, B, C and D with reference to gametogenesis in humans in the flow chart given below.



Ans : **SQP 2008**

A = Inhibition of GnRH and FSH.

B = FSH (Follicle Stimulating Hormones)

C = Secondary Sex organ.

D = Stimulates Spermiogenesis.

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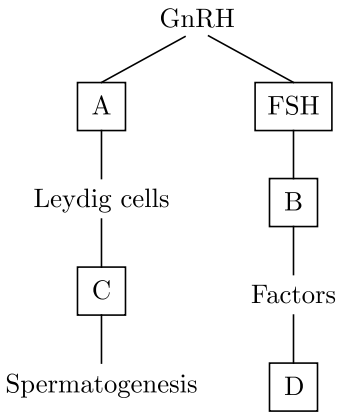
158. Identify A, B, C and D with reference to gametogenesis in humans, in the flow chart given below.



Ans : FOREIGN 2012

A = LH (Leutenising Hormone)

B = Sertoli cells

C = Testosterone

D = Stimulates spermiogenesis.

159. Explain the following :

1. Failure of testes to descend into the scrotum produces sterility.
2. Spermatids possess a haploid chromosome number.

Ans : COMP 2010

1. If the testes do not descend in the scrotum the formation of sperms is not possible and thus the person will become sterile. Its temperature remains 2°C below the body temperature which is essential for the formation of sperms. This keeps the testes at a cooler temperature than the body temperature.
2. During the maturation phase of spermatogenesis each primary spermatocyte undergoes two divisions. The first division is meiotic, producing secondary spermatocytes each containing haploid number of chromosomes. The second division is a mitotic. Each secondary spermatocyte then undergoes mitotic division producing four haploid spermatids. The spermatids then develop into haploid sperms.

160. Distinguish between Corona radiata and zona pellucida.

Ans : OD 2015

Difference between Corona radiate and Zona pellucida are as follows :

	Corona radiata	Zona pellucida
1.	It lies outside zona pellucida.	Human ovum is spherical and non-motile.
2.	They are radially arranged epithelial cells of cumulus orphorus.	It is enclosed by vitelline membrane.
3.	These cells remain continuous to cling to ovum for some time after ovum is discharged.	It is again covered by a transparent, non-cellular layer called zona pellucida.

161. Describe the composition of semen.

Ans : DELHI 2018

Composition of Semen consists the seminal fluid of prostate gland as well as the seminal vesicle origin and sperm. Volume of ejaculation differs from person to person. Abstinence plays a role in it. Each ejaculate on an average is 3.5ml. It contains 50 to 150 million sperm/ml. Life span of human sperm, after ejaculation is 24-78 hours. The fructose and citric acid of seminal fluid are utilised as source of energy to impart the motility to sperm.

162. Mention the functions of the following:

1. Epididymis
2. Fallopian tubes

Ans : SQP 2020

1. **Epididymis :** Attached to the testis is a long coiled epididymis , where the maturation of spermatids to functional spermatozoa occurs. The epididymis stores sperms temporarily. Through epididymis, the sperms pass into vas deferens.
2. **Fallopian Tube or Oviduct :** These are two small tubes of about 12 cm in length lying on either side of uterus. Fallopian tube opens into uterus. Each fallopian tube is a muscular tube starting near the ovary from an open funnel shaped end. It also provides the site fertilization.

163. Why is CuT considered a good contraceptive device to space children?

Ans : FOREIGN 2023

CuT is copper releasing Intra Uterine device presently available and is a good contraceptive device to space children.

1. Cu ions released reduce the sperm motility.]
2. Cu ions released inhibit the fertilizing capacity of the spermatozoa in humans.

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164. Distinguish between Oestrous cycle and Menstrual cycle.

Ans : COMP 2007

Difference between Oestrous Cycle and Menstrual Cycle are as follows :

	Oestrous Cycle	Menstrual Cycle
1.	It has a heat period during which sexual desire of animal is maximum.	The heat period of maximum sexual desire does not occur.
2.	It permits copulation only during a definite period, fertile period or oestrous of heat.	It permits copulation to be performed at any time during sexual cycle.

165. Explain the function of each of the following:

1. Coleorhiza
2. Umbilical cord
3. Germ pores.

Ans : DELHI 2005

1. **Coleorhiza :** It is a protective covering of radicle.
2. **Umbilical cord :** The placenta remains united to embryo via an umbilical cord that helps in transport of substances to and form embryo.
3. **Germ pores :** The pollen tube emerges through these pores in the pollen grains in exine.

166. Differentiate between major structural changes in the ovary during the follicular and luteal phase of the menstrual cycle.

Ans : FOREIGN 2005

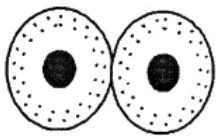
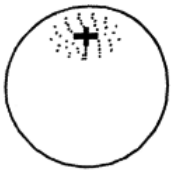
Difference between follicular phase and Luteal Phase of menstrual cycle are as follows :

	Basic	Follicular phase	Luteal Phase
1.	Other name	This is called proliferative phase.	It is called secretory phase.
2.	Explanation	It beings on 5 day of cycle and lasts upto 14th day of endomentrium becomes normal. It is growth of follicle an follows menstruation.	Under the LH the corpus luteum produces progesterone. Its duration is 15-18 days.

167. Differentiate between Holoblastic cleavage and Meroblastic cleavage.

Ans : DELHI 2013

Difference between Holoblastic cleavage and Meroblastic cleavage are as follows :

	Holoblastic Cleavage	Meroblastic Cleavage
1.	The fertilized egg divides completely into two blastomeres.	The zygote divides incompletely.
2.	It is a characteristic of microlecithal and alecithal eggs.	It is a characteristic of centrolecithal and polyecithal eggs.
3.	e.g. Amphioxus, man.  Holoblastic cleavage	e.g., Insects and birds.  Meroblastic cleavage

168. Compare the structure of mature mammalian sperm an ovum.

Ans : SQP 2017

	Mammalian Sperm	Mammalian Ovum
1.	It is long, motile without reserve food.	It is large, passive and alecithal.
2.	It bears acrosome on the head.	It does not bear acrosome but it is surrounded by vitelline membrane, zona pellucida and corona radiata.
3.	It consists of head, neck, middle piece and tail.	It consists of centrally located nucleus surrounded by cytoplasm.
4.	Its middle piece contains oxidative enzymes to supply energy for metabolism and movement.	It gets food supply from the fallopian tube and uterine secretion.
5.	It moves by the undulating movement of the tail.	It moves by the ciliary action of the fallopian tube.

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6.	It Produces antifertilizin (sperm lysin) during fertilization.	It produces fertilizn at the time of fertilization.

169. Distinguish between Spermatocyte and Oocyte.

Ans : FOREIGN 2005

Difference between Spermatocyte and Oocyte are as follows :

	Spermatocyte	**Oocyte**
1.	During growth phase of spermatogenesis spermatogonial cells grow in size. Now each cells is called primary spermatocyte.	The growth phase is very large. Oogonium grows to form primary oocyte.
2.	Each primary spermatocyte undergoes meiosis I division to form two smaller secondary spermatocytes.	Each primary oocyte undergoes meiosis. The first division results into a secondary oocyte and a polar body. The II division forms one egg and a small polar body.

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170. Differentiate between:

1. Internal fertilization and External fertilization.
2. Egg and Embryo.

Ans : FOREIGN 2010

1. Difference between Internal fertilization and External fertilization are as follows :

	Internal fertilization	**External fertilization**
1.	Takes place inside the body of the animal in oviparous, ovoiviparous and viviparous animals.	Takes place outside the body of the animal in oviparous animals like frog. They do not have frog. They do not have copulatory organ.
2.	There is no need of additional medium.	Medium like water is essential.

2. Difference between Egg and Embryo are as follows:

	Egg	**Embryo**
1.	It is an unfertilized female gemate.	The zygote which is formed by the fusion of male and female gametes form the embryo.
2.	It is haploid.	It is diploid.
3.	It is the result of oogenesis.	It is formed as a result of fertilization.

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171. In which part of the human female reproductive system do the following events take place?

I - Release of 1st polar body.

II - Release of 2nd polar body.

III - Fertilisation,

Ans : SQP 2005

I. In the ovary of human female.

II. In the Isthmus - ampullary junction of the fallopian tube of female.

III. In the Fallopian tubes.

172. Differentiate between Egg and Zygote.

Ans : OD 2013

Difference between Egg and Zygote are as follows:

	Egg	**Zygote**
1.	It has haploid number of chromosomes.	It has diploid number of chromosomes.
2.	It is the result of gametogenesis (oogenesis).	It is the result of fertilization.

173. From where do signals for parturition originate and what does maternal pituitary release for stimulating uterine contractions for child birth?

Ans : COMP 2014

Parturition is the process of child birth i.e., the delivery of foetus. Signals for parturition originate from a fully formed foetus as well as placenta (all connections between mother and foetus). Then there is induction of mild uterine contractions. This is known as foetal ejection reflex. All this release oxytocin hormone (birth hormone) from the mothers (maternal)pituitary gland. Therefore, uterine contractions become stronger and stronger. More oxytocin is produced from master gland. At last, the baby comes out form uterus by birth canal. Later on placenta is

expelled out. This is the role played by pituitary gland in parturition.

174. Distinguish between Graafian follicles and Corpus luteum.

Ans : OD 2023

Difference between Graafian follicles and Corpus luteum are as follows :

	Graafian follicles	Corpus luteum
1.	A large number of Graafian or ovarian follicles are embedded in the cortical layer of the ovary.	It secretes progesterone hormone which promotes the development of the mammary glands during pregnancy and protects uterus from contraction. It is a yellow body formed in the ovary form the ovarian folicle.
2.	Rupture of graafian follicle releases ovum. It is called ovulation.	It acts as endocirne gland.

175. What is colostrum? Why is it important to be given to the newborn infants?

Ans : FOREIGN 2005

The first milk drops which comes out from the mother's mammary glands just after child birth are called colostrum. Colostrum is rich in calories and protein. It possesses only that provide passive immunity for the new born infant. Three of four days after delivery, the breasts begin to secrete milk. Synthesis of milk from these glands is stimulated by the pituitary hormone called prolactin (PRL). Its release is stimulated by a rise in the level of oxytocin secreted by neurohypophysis when the baby begin nursing. Milk contains an inhibitory peptide. The peptide accumulates in the glands and suppresses milk production when the gland are not fully empty. It is an autocrine function.

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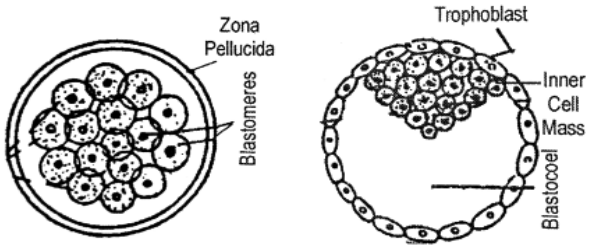
176. Distinguish between Morula and Blastula

Ans : SQP 2005

Difference between Morula and Blastula are as follows :

	Morula	Blastula
1.	Morula is a solid ball of cells like a mulberry.	Blastula is a hollow structure having a blastocoel or segmentation cavity in the centre of it.
2.	Morula consists of an outer layer of micromeres and inner layer of macromeres.	Blastula consists of outer trophoblast and an inner cell mass.
3.	Cells are rounded.	Cells are flattened.



177. Differentiate between Blastulation and Gastrulation.

Ans : DELHI 2005

Difference between Blastulation and Gastrulation are as follows:

	Blastulation	Gastrulation
1.	In blastulation there is rapid mitosis division of the zygote.	In gastrulation there are slow mitotic divisions.
2.	Morphogenetic movements absent.	Morphogenetic movement present.
3.	Formation of a single layered blastula with a central blastocoel.	Formation of a three layered gastrula with arechenteron or gut.
4.	It is lined by one layer.	It is lined by two layers and later on three.

178. Write the function of each of the following :

1. Middle piece in human sperm.
2. Tapetum in anthers.
3. Luteinizing hormone in human males.

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Ans : SQP 2013

1. **Middle Piece in Human Sperm :** It contains mitochondria which provide energy for motility to sperm.
2. **Tapetum in Anthers :** Tapetum nourishes developing pollen grains.
3. **Luteinizing Hormone in Human Males :** Luteinizing hormone in males acts at Leydig cells. It initiates synthesis and secretion of androgen hormones.

179. Differentiate between Trophoectoderm and Ectoderm

Ans : OD 2024, DELHI 2007

Difference between Trophoectoderm and Ectoderm are as follows :

	Trophoectoderm	Ectoderm
1.	It is the expansion of outer layer of blastodermic vesicle.	It is a layer formed after gastrulation from the blastocyst.
2.	It draws food for embryo form uterine circulation of mother.	It gives rise to many important organs of the developing embryo including the nervous system.
3.	It helps in feeding during development.	Ectoderm does not perform the function of feeding

180. Name the source of gonadotropins in human females. Explain the changes brought about in the ovary by these hormones during menstrual cycle.

Ans : DELHI 2005

Gonadotropins : These are produced by anterior pituitary gland (Adenogypophysis).FSH (follicle stimulating hormone) and LH (Luteinising hormone) are two gonadotropins.

Changes in the ovary : FSH initiates follicular development as well as the secretion of estrogens by follicle cells of ovary.

FSH and LH both attain a peak level around mid of cycle (app. 14 days).

Maximum level of LH (LH surge) induces ovulation. (The rupture of mature follicle and release of ovum subsequently).

The LH stimulates formation of corpus luteum (an endocrine gland) from the ruptured follicle; Progesterone is secreted from the corpus luteum (to maintain pregnancy).

181. Difference between the location and function of Sertoli cells and Leydig cells.

Ans : FOREIGN 2012

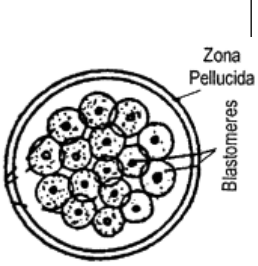
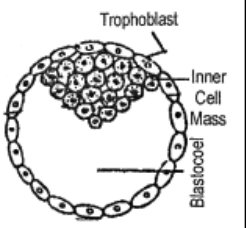
Difference between location and function of Sertoli Cells and Leydig cells are as follows :

	Sertoli Cells	Leydig Cells
1.	Sperm heads are embedded in sertoli cells in the seminiferous tubule.	Leydig cells are located in the regions outside the seminiferous tubules called interstitial spaces.
2.	Sertoli cells provide nourishment to the germ cells.	They synthesize and produce testicular hormones called the androgens.

182. Differentiate between morula and blastocyst as stages in human embryonic development. Which of these stages gets implanted in the uterine wall and about how many days after fertilization?

Ans : COMP 2005

Difference between Morula and Blastocyst in humans are as follows :

	Morula	Blastocyst
1.	Embryo at 16 celled stages is called morula.	It has a cavity called blastocoel. It consists of 32 cells.
2.	It resembles mulberry to that of fruits. 	It consists of an outer trophoblast and inner cell mass. 

After one week of fertilization the blastocyst gets implanted in the uterine wall by implantation.

183. Describe the Lactational Amenorrhea method of birth control.

Ans : SQP 2005

Lactational Amenorrhea is a method of birth control. It is the absence of menstruation in females. Its basis is "ovulation and cycle do not take place during the period of intense lactation following child birth or parturition". So as long

as a mother feeds her child by breast milk, the enhancement of conception are almost nil.

LONG ANSWER QUESTIONS

184. Giving suitable examples, describe the process of sex-determination.

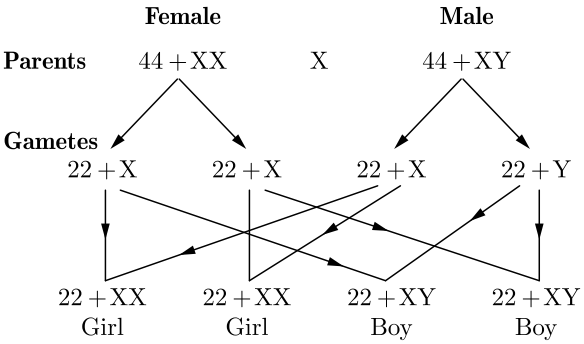
Ans : OD 2017

Sex determination is the mechanism by which sex of the foetus is determined during embryonic development in sexually reproducing animals. The pattern of sex determination vary from species to species. In humans, it is called as XX-XY pattern. Each human cell has 23 pairs of chromosomes. Out of these 22 pairs of chromosomes are called autosomes. They are similar in both men and women. They carry genes for somatic characters.

The chromosomes of 23rd pair are different in males and females. These are called sex chromosomes. They are responsible for the development of sex in human beings. In human females, the two sex chromosomes are similar (homogametic) and are represented by XX chromosomes. Thus, a human female has 44+XX chromosomes. They produce only one type of egg, each with 22 autosomes and one X-chromosome (22+X).

While in human males, the two sex chromosomes are dissimilar or heterogametic and are represented as XY. The Y-chromosome is much smaller. A human male, therefore, has 44+XY chromosomes. They produce two types of sperms, 50% with X-chromosomes and 50% with Y-chromosomes in addition to 22 autosomes (22+X and 22+Y).

The sex of child is determined at the time of fertilisation by the sperm that fertilises the egg. Y-chromosome bearing sperms produce male child, X-chromosome bearing sperms produce female child.



185. With the help of suitable sketches, describe the process of spermatogenesis.

Ans : SQP 2005

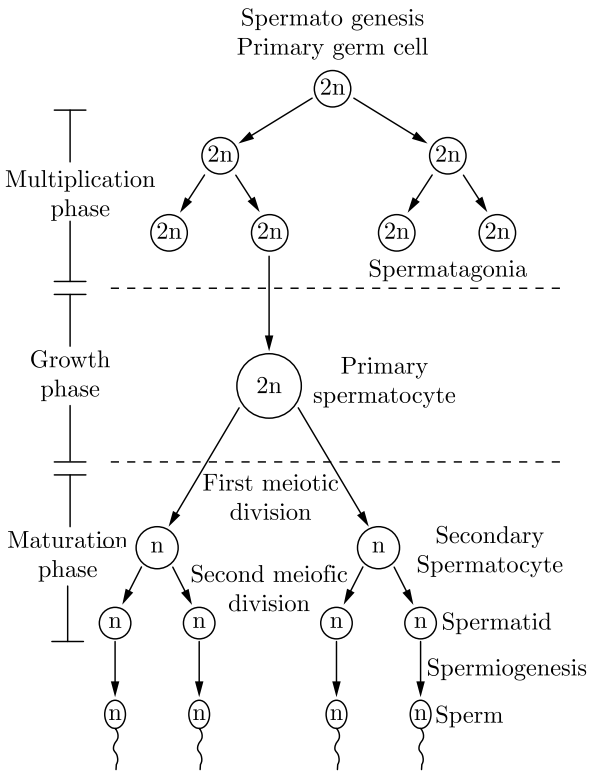
The process of formation of male gametes, sperms from male germinal cells in testies is called as spermatogenesis. This process start after puberty in males and occurs throughout the entire lifespan.

1 **Multiplication phase :** Spermatogonia (sperm mother cell) present on the inner wall of seminiferous tubules multiply by mitotic division and increase in number. They are called as spermatocytes.

2 **Growth phase :** Spermatocytes grow and increase in size, accumulate nutrients and replicate DNA. They are termed as primary spermatocyte.

3 **Maturation phase :** Each primary spermatocyte undergoes two successive maturation divisions. The first is reductional or meiotic division that produce two haploid secondary spermatocytes. They undergo second maturation mitotic division to produce a total of four haploid spermatids.

4 **Differentiation phase :** The spermatids are transformed into sperms by the process of spermeiogenesis. The sperm's head get attached to sertoli cells to draw nourishment and are finally released from the seminiferous tubules by the process called spermiation.



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186. Describe gastrulation and formation of germ layers.

Ans : **OD 2015**

Gastrulation is the process of highly integrated cell tissue migrations of prospective endodermal and mesodermal areas to their definite positions into the interior of the embryo. These movements are self determined and interdependent and are termed morphogenetic movements, creating new relationships and ultimately a triploblastic embryo majority of higher animals.

In almost all animals it results in establishment and differentiation of three primary germinal layers (ectoderm, mesoderm and endoderm) and establishment of nuclear differentiation. It also marks beginning of the control of genetic factors over development. It starts immediately after implantation. In this, cells of blastodermic vesicle visibly move in small masses to their final and pre-determined positions. These movements are interdependent and are called morphogenetic movements. These movements change a hollow spherical blastula into a complex gastrula with three primary germ layers i.e., ectoderm, mesoderm and endoderm. The developmental fate of cells of each of these primary germ layers is determined to develop specific organs and organ-systems of the individual and that fate is same in all the triploblastic animals.

Formation of layers by gastrulation : Gastrulation includes the formation of following structures :

1. **Formation of Endoderm :** The blastodermic vesicle enlarges and cells present on the lower surface of the embyryonal knob detach by delamination from the embryonal knob. The part of endoderm located under the embryonal knob is called embryonic endoderm which later forms embryonic gut, while the remaining part of endoderm along with trophoblast forms the yolk sac.
2. **Formation of Embryonic Disc and Mesoderm :** Meanwhile, the blastocyst continues to grow due to absorption of more and more uterine milk. The embryonal knob stretches and cells of Rauber start breaking off and dispersing. So the cells of embryonal knob from a regular layer called embryonic disc which becomes continuous with the trophoblast. Embryonic disc is differentiated into cephalic, embryonic and caudal regions. Formation of embryonic mesoderm starts at the caudal region of the embryonic disc where cells undergo rapid proliferation and form a localized thickening of the embryonic disc and form the mesodermal layer between ectoderm and endoderm.
3. **Formation of Ectoderm :** The remaining cells of blastodisc become columnar and form ectoderm.

Fate of germ layers : Each of the three germ layers gives rise to definite tissues, organs and systems of the body. Their fate in embryo and adult has been listed below.

(i) **Ectoderm :** Epidermis and skin derivatives, nervous system, eye etc.
(ii) **Mesoderm :** Muscular tissue, connective tissue, kidney, endoskeleton etc.
(iii) **Endoderm :** Gut, glands of stomach and intestine, lungs etc.

NODIA

187. Draw neat, clean and well labelled diagram of female reproductive system of human being. Write the functions of its different parts.

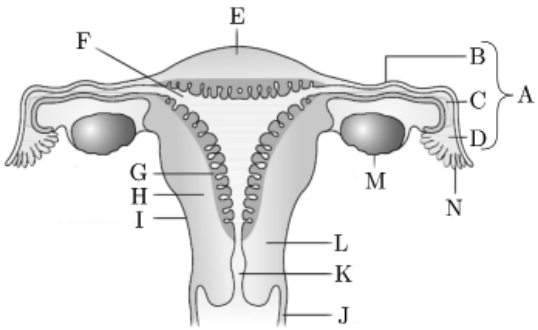
Ans : **COMP 2005**

Human female reproductive system consist of following parts.

1. **Ovaries :** It is the primary reproductive organ of females. It consists of pair of small glands located on either sides of the pelvic body cavity lateral to the superior portion of the uterus. Ovaries produce female sex hormones such as estrogen and progesterone as well as ova. Each month during ovulation, a nature ovum is released.
2. **Fallopian tubes :** A pair of muscular tubes called fallopian tube extend from the left and right superior corners of the uterus to the edge of the ovaries their function is to pick up released ova and transport then to the uterus.
3. **Uterus :** It is a hollow, muscular, pear-shaped organ. Its main function is to support to the developing fetus during pregnancy.
4. **Vagina :** It is an elastic, muscular tube connects the cervix of the uterus to the exterior of the body. The vagina functions as the receptacle for the penis during sexual intercourse and carries sperm to the uterus and fallopian tubes. It also serves as the birth canal by stretching to allow delivery of the fetus during childbirth.
5. **Vulva :** It is the collective name for the external female genitalia located in the pubic region of the body. The vulva surrounds the external ends of the urethral opening and the vagina and includes the mons pubis, labia majora, labia minora and clitoris. The mons pubis is a raised layer of adipose tissue between the skin and the public bone that provides cushioning to the vulva. The inferior portion of the mons

pubis splits into left and right halves called the labia majora. The mons pubis and labia majora are covered with pubic hairs. Inside of the labia majora are smaller, hairless folds of skin called the labia minora that surround the vaginal and urethral openings. On the superior end of the labia minora is a small mass of erectile tissue known as the clitoris that many nerve endings for sensing sexual pleasure.

6. **Breast :** The breasts are accessory reproductive glands. These are specialized organs of the female body that produce milk to feed infants.



A- B(Isthmus), C(Ampulla), D(Infundibulum)
E- Uterine fundus
F- Uterine cavity
G- Endometrium
H- Myometrium
I- Perimetrium
J- Vagina
K- Cervical canal
L- Cervix
M- Ovary
N- Fimbriae

188. Describe the different changes during menstrual cycle occurring in a woman.

Ans : **SQP 2005**

Menstrual cycle is a series of cyclic changes occurring in the reproductive tract of female with the periodicity of 28 days. It is also known as endometrial cycle. It occur from puberty to menopause. It is characterized by loss of vaginal blood (breaking of endometrium wall of uterus). It is under Influenced of hormones secreted by pituitary gland (FSH and LH) and ovary (progesterone and oesterogen).

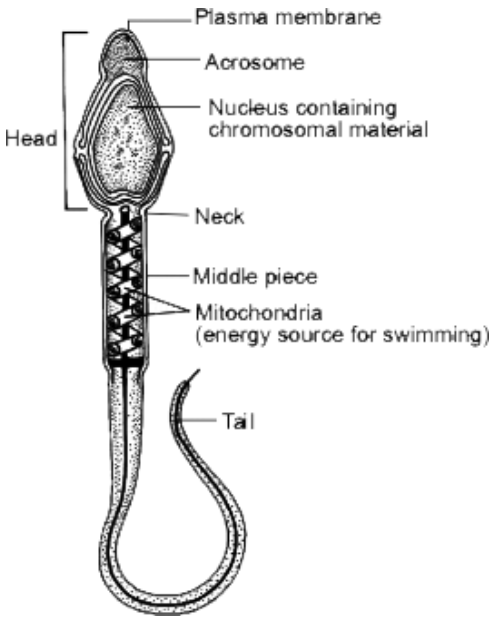
Initiation of menstruation at puberty is called menarche. While in older age around 50 yrs in females menstruation ceases and is called menopause.

1. **Menstrual phase :** It lasts for about 3-5 days in which the uterine lining dies and sloughed off due to the deficiency of progesterone. Blood vessels rupture causing bleeding, called menstruation or menstrual flow.
2. **Follicular or Proliferative Phase :** It lasts for about 14 days in which primary follicles develop into fully mature Graafian follicle, thereby also regenerating the endometrium by proliferation.
3. **Ovulatory Phase :** It takes place in the middle of Cycle (about 14th day) where bouth LH and FSH secretion reach maximum, inducing the rupture of Graafian follicle and release of ovum which is known as ovulation.
4. **Luteal Phase or Secretory Phase :** It lasts for about 10 days in which the remaining part of Graafian follicle transforms into corpus luteum. In the absence of fertilisation, the corpus luteum disintegrates, leading to the onset of new menstrual cycle.

189. Show well labelled diagram of the structure of human sperm and write about its components in brief.

Ans : **OD 2024, 2015**

Human sperm cell is a male reproductive cell which is microscopic and tadpole-shaped. It about 2-5 μm in diameter and 60 μm long. A plasma membrane encloses the entire sperm. It consists of a head, neck, middle piece and a tail.



NODIA

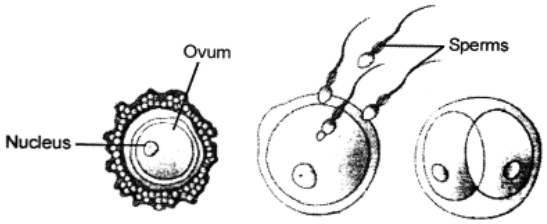
1. **Head :** It is made up of a large haploid nucleus and a small anterior cap-like structure, called acrosome, which contains hydrolytic enzymes that helps in penetration of egg during fertilisation.
2. **Neck :** It contains two centrioles lying one behind and at right angles to the other. The proximal centriole help in the first cleavage of the zygote and the distal centriole gives rise to the axial filament of the sperm.
3. **Middle Piece :** It contains various mitochondria which produce energy for the movement of the tail that facilitates sperm motility essential for fertilisation.
4. **Tail :** It is long, slender, tapering structure formed of cytoplasm. A fine thread, the axial filament arises from the posterior centriole and transverses the middle piece and the tail. It help spermatozoa to swim by vibrating their tail in a fluid medium in search of ova.

190. 1. One of the sperms is observed to penetrate 'a' of the ovum, as shown in the above diagram. Name 'a'.
2. How is the sperm able to do so?
3. Where does this exactly in the fallopian tube occur?
4. Explain the events there after upto morula stage.

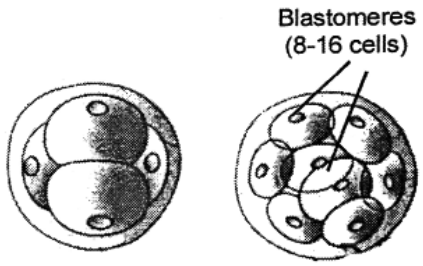
Ans : **COMP 2014**

1. a = Zona pellucida.
2. Penetration of sperm into ovum = Fertilisation : During copulation, semen is transferred into vagina of female human → motile sperms move through cervix → enter the uterus and reach the ampullary-isthmic junction of the fallopian tube. Ovum released from ovary also reaches the ampullary-isthmic junction → where fertilization occurs. A sperm comes in contact with the zona pellucida layer of the ovum and induces changes in the membrane to block entry of other sperms. Enzymes of the acrosome of the sperm help to dissolve zona pellucida and plasma membrane of the ovum to gain entry of the sperm into the cytoplasm of the secondary oocyte.

   Entry of sperm induces completion of IInd meiotic division of secondary oocyte, that results in the formation of a halploid oocyte and a small second polar body. Even before nucleus of the oocyte is organised, it fuses with sperm nucleus (fertilization) to form a diploid zygote.
3. **In fallopian tube :** Fertilization in human female is internal. It take place in the ampulla of the fallopian tube.
4. **Events :** The morula is formed in the fallopian tube of human female. The zygote undergoes, cleavage (segmentation) to form blastomeres by successive mitotic divisions. They develop into 8-16 cell stage that is known as the morula. Morula is a solid sphere.



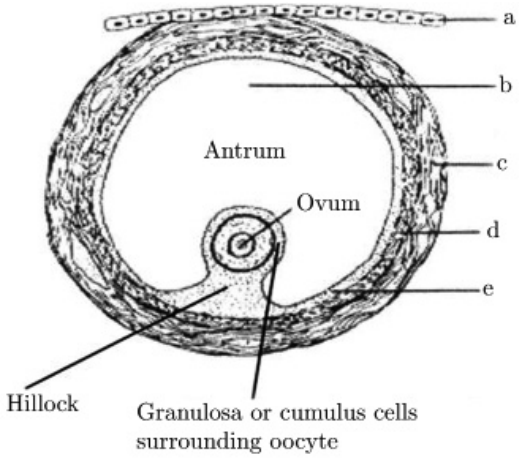
(a) Ovum (b) Fertilization (c) Cleavage



(d) 4-cells stage (e) Morula stage

191. Draw well labelled diagram of graafian follicle (mature) and mention its characteristics.

Ans : **OD 2011**



1. Germinal epithelium
2. Fluid filled follicular cavity
3. Theca externa-androgen prod., testosterone LH receptors Fibrous tissue

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4. Theca interna- E & P Vascular tissue
5. Granulosa cells- E & P FSH and LH receptors

Characteristics of Graffian Follicle- The Graafian follicle is the follicular stage after the first meiotic division but before ovulation. It therefore contains haploid oocyte. It is characterized by a large follicular antrum that makes up most of the follicle. The secondary oocyte, having undergone the first meiotic division, is located eccentrically. It is surrounded by the zone pellucida and a layer of several cells known as the corona radiata. When released from the Graafian follicle and into the oviduct, the ovum will contain three layers oocyte, zone pellucida and corona radiata.

192. What is menstrual cycle? Which hormones regulate menstrual cycle?

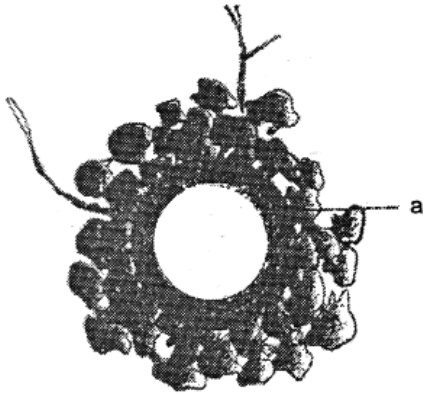
Ans : **DELHI 2005**

The reproductive cycle of a human female starts from the age of 13-15 at puberty and stops at the age 45-49 in the onset of menopause. After the menopause the ovarian cycle stops and the women is not able to bear children.

Menstrual cycle : It is characterised by menstruation, a process in which blood, mucus and is regulated by the action of hormones oestrogen and progesterone on the uterine tissue. Oestrogen stimulates the growth of myometrium (uterine smooth muscle) and endometrium. Progesterone acts upon the oestrogen primed endometrium to convert it into actively secreting tissue which provides favourable environment for it into actively secreting tissue which provides favourable environment for implantation of the fertilized ovum. The endometrial changes throughout the normal non-pregnant menstrual cycle are regulated by oestrogen and progesterone. Normally a cycle is of 28 days but variations do occur. The cycle is divided into four stages.

1. The soft tissue of inner uterine epithelial lining disintegrates with the result bleeding occurs. The unfertilized eggs and soft tissues are discharged. The discharge continues for 3 to 5 days.
2. Uterine epithelial lining reappears. Maturation of Graafian follicle and ovum inside the ovary takes place. The stage starts at the end of menstruation and continues upto 10 to 14 days form the first day of menstruation.
3. After 10 to 14 days the mature ovum is released from the Graafian follicle which comes in to the fallopian tube.
4. At this stage corpus luteum is formed from the Graafian follicle of released ovum. This secretes hormones. This hormone prepares the uterus for receiving the fertilized ovum.

NODIA



193. Explain the process of fertilization of an ovum in humans. Trace the events that occur after fertilisation upto the implantation of blastocyst.

Ans : **COMP 2005**

Fertilisation : During copulation, semen is transferred into vagina of female human ⟶ motile sperms move through cervix ⟶ enter the uterus and reach the ampullary-isthmic junction of the fallopian tube. Ovum released from ovary also reaches the ampullary-isthmic junction ⟶ where fertilization occurs. A sperm comes in contact with the zona pellucida layer of the ovum and induces changes in the membrane to block entry of other sperms. Enzymes of the acrosome of sperm help to dissolve zone pellucida and plasma membrane of the ovum to gain entry of the sperm into the cytoplasm of the secondary oocyte.

Entry of sperm induces completion of IInd meiotic division of secondary oocyte, that result in the formation of a haploid oocyte and a small second polar body. Even before nucleus of the oocyte is organised, it fuses with sperm nucleus (fertilization) to form a diploid zygote.

Development of Zygote upto Implantation :

Cleavage : The zygote moves through isthmus towards uterus and it undergoes successive (mitotic) divisions called cleavage. It forms 2, 4, 8, 16 daughter cells. Daughter cells are known as the blastomeres.

Morula : At the 16-celled stage this embryo is a solid sphere and is known as a morula.

Blastocyst : The cell divisions continue in morula. The blastomeres become arranged along periphery leaving a central cavity, the blastocoel. Embryo at this stage is a blastocyst.

Cells now become arranged as an outer layer, the trophoblast and an inner group of cells called inner cell mass (ICM) attached to trophoblast

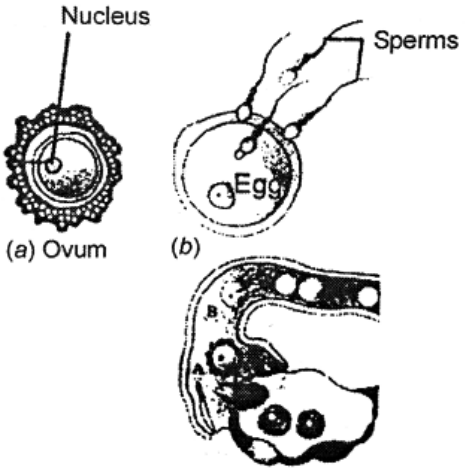
and projecting into the cavity called blastocoel.
Implantation : The trophoblast layer gets attached to the endometrium. The cells of endometrium divide rapidly and cover the blastocyst. So the blastocyst gets embedded in the endometrium; this process is called implantation. The cells of inner cells mass (ICM) differentiate to form the embryo proper.

194. Write the specific location and the functions of the following cells in human males:
(a) Leydig cells
(b) Sertoli cells
(c) Primary spermatocyte
Ans : **SQP 2005**

Location and Functions of (In human males):
(a) **Leydig 's cell :** These are known as interstitial cells. They are endocrine in nature. They synthesize and produce male sex hormones called the androgens. The androgens are testicular hormones. Leydig's cells lie in that interstitial spaces outside seminiferous tubules in testis of male.
(b) **Sertoli cell :** The seminiferous tubules are lined buy two kinds of cell : (i) male germ cells and (ii) the sertoli cells. These cells provide nourishment to the developing germs cells or spermatogonia etc.
(c) **Primary spermatocyte :** The spermatogonia contain diploid (2N=46) chromosomes in human male; certain of these spermatogonia are called primary spermatocytes undergo meiosis or reduction division. Primary spermatocytes lie in the seminiferous tubule inner to the spermatogonia. Primary spermtocyte completes first meiosis and forms two equal size halpoid (N) cells that are known as the secondary spermatocytes (N=23)

195. Where does fertilization occur in humans ? Explain the events that occur during this process?
Ans : **COMP 2005**

Fertilization occurs in fallopian tube of human female. During copulation, semen is transferred into vagina of female human. The motile sperms move through the cervix, enter the uterus and reach the ampullary-isthmic junction of the fallopian tube. Ovum released form ovary also reaches the amullary-isthmic junction, where fertilization occurs. A sperm comes in contact with the zona pellucida layer of the ovum and induces changes in the membrane to block entry of other sperms. Enzymes of the acrosome of sperm help to dissolve zona pellucida and plasma membrane of the ovum to gain entry of the sperm into the cytoplasm of the secondary oocyte.



Entry of sperm induces completion of IInd meiotic division of secondary oocyte, that results in the formation of a haploid oocyte and a small second polar body. Even before nucleus of the oocyte is organised, it fuses with sperm nucleus (fertilization) to form a diploid zygote.

196. Name and explain the process of formation of a mature female gamete in humans. Name and mention the role of hormones in regulating the process.
Ans : **OD 2016**

In human female in the ovary primary oocytes are formed form the gamete mother cells (oogonia) during the process of oogenesis at child birth, childhood as well as at puberty.
Each primary oocyte is now enclosed by a layer of granulosa cells and is called primary follicles. Many of these degenerate from birth to puberty. The primary follicle then is enclosed by a new theca, and becomes secondary follicle. It changes into tertiary follicle that has filled cavity (antrum). It grows in size to complete first meiotic division. It divides into 2 unequal cells called secondary oocyte and a polar body (haploid). The tertiary follicle becomes a mature follicle secondary oocyte develops zona pellucida layer. The graafian (mature) follicle ruptures to release egg (ovum). It is called ovulation.
Role of Gonadotropins : The follicle stimulating hormone releasing factor (FSH-RF) from hypothalamus triggers the release of FSH from the pituitary. In follicular phase of menstrual cycle. FSH initiates the development of follicles in the ovary. The cells of follicles synthesis estrogen, principally estradiol which stimulates the uterine epithelium to porliferate. When the estrogen

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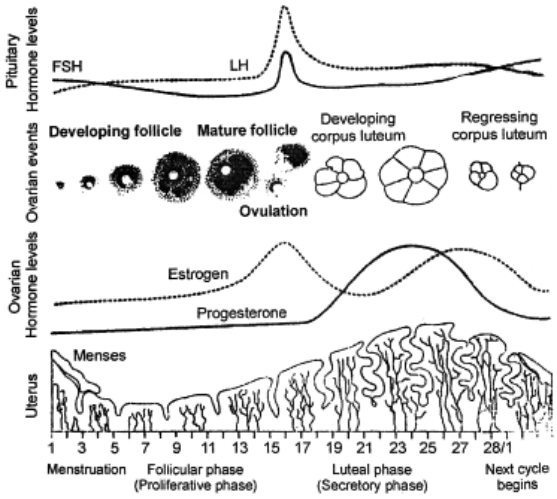
in the blood reaches a certain concentration, it also acts on the pituitary to shut down FSH production and on the hypothalamus to result in the discharge of luteinizing hormone releasing factor (LH-PF) to the pituitary. The pituitary now releases LH to the circulation during LH surge in ovulatory phase. In combination with residual FSH, it results in ovulation.



1. **Fertilization :** During copulation, semen is transferred into vagina of female human. The motile sperm move through the cervix, enter the uterus and reach the ampullary-isthmic junction of the fallopian tube. Ovum released from ovary also reaches the ampullary-isthmic junction, where fertilization occurs. A sperm comes in contact with the zonal pellucida layer of the ovum and induces changes in the membrane to block entry of other sperms. Enzymes of the acrosome of sperm help to dissolve zona pellucida and plasma membrane of the ovum to gain entry of the sperm into the cytoplasm of the secondary oocyte.

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2. **Development of Zygote upto Implantation :** Cleavage : The zygote moves through isthmus towards uterus and it undergoes successive (mitotic) divisions called cleavage. It forms 2, 4, 8, 16 daughter cells. Daughter cells are known as the blastomeres.

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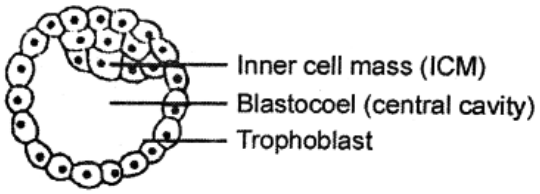
   Implantation : The trophoblast layer gets attached to the endometrium. The cells of endometrium divide rapidly and cover the blastocyst. So the blastocyst gets embedded in the endometrium; this process is called implantation. The cells of inner cell mass differentiate to form the embryo proper.



197. Briefly describe the structure of ovary of human female.

Ans : **DELHI 2010**

Microscopic Structure Anatomy of ovary of human female : It consists of 2 parts-cortex and medulla (inner). Tunica albuginea covers cortex and gives white color to it outside this is germinal epithelium. The ova are seen in various stages of maturation there. They remain closed in ovarian follicles. A follicle is an oocyte enclosed by one/ more layers of granulosa cells (derived from germinal epithelium). Follicular cells divide and form granulosa layer. Oocyte is enclosed by Zona pellucida in mature follicle. It is approx. 2.5cm in diameter. It has fluid filled cavity, the antrum. This fluid is called liquor follicle. A mature follicle adheres to its wall by a pedicel named cumulus oophours. The mature follicle bursts and then ovum is released (it is called ovulation). Soon after it corpus luteum is formed by granulosa cells and interstitial cells. Corpus luteum acts as endocrine organ and releases progesterone and estrogen hormones. Some follicles regress and disappear. It is known as follicular atresia.

198. Describe the post-zygotic events leading to implantation and placenta formation in humans. Mention any two functions of placenta.

NODIA

Ans : COMP 2005

The post-zygotic events that lead to implantation and formation of placenta in Humans : The zygote undergoes cleavage division and forms 4, 8, 16 daughter cells called the blastomeres. At 16 called stage, the embryo is solid sphere of cells. It is known as the morula.

The morula divides to form blastocyst that possesses a cavity called the blastocoel and an outer layer of cells called the trophoblast. The inner cell mass (ICM) lies attached to the peripheral layer, the trophoblast.

The trophoblast gets attached to the uterine wall called endometrium. The cells of endometrium divide quickly and cover blastocyst. The blastocyst gets embedded in endometrium through the process of implantation.

The cells of inner cell mass differentiates into the embryo.

The pregnancy of Embryonic Development : Trophoblast differentiates into 2 layers. Outer layer secretes enzymes to dissolve endometrium of uterus. The inner layer grows out as finger-like projections known as the chorionic villi into uterine stroma. They are surrounded by the uterine tissue and maternal blood vessels. Chorionic villi and uterine tissue become interdigitated to form structural and functional unit, named as the placenta.

Two functions of Placenta :

1. It facilitates the supply of oxygen and nutrients to the embryo.
2. It acts as an endocrine gland and secretes many hormones like hcG, hPL, relaxin, estrogens and progesterone etc.

CASE BASED QUESTIONS

199. The process of spermatogenesis initiates in testes that originates from the Primedial Germ cells (PGCs). This process in males starts at puberty and includes various different stages suchas multiplication, growth, maturation and differentiation.

(i) What does the undifferentiated germ cell present in the inside wall of seminifersus tubule of tests is called ?

(ii) What happens to some of the spermategonia during growth phase ?

(iii) How many secondary spermatocytes are produced during maturation phase.

(iv) Name the hormone whose increase at the age of puberty initiates spermategenesis.

Ans :

(i) Spermatogonia (sperm mother cell).

(ii) They differentiates to produce primary spermatocytes.

(iii) The primary spermatocyte undergoes first meiotic division and produces two secondary spermotocytes.

(iv) Gonadotropin Releasing hormone (GnRH).

200. The major events of the menstrual cycle are as follows as the cycle starts with the menstrual phase, when menstrual flow occurs and it lasts for 3-5 days. The menstrual flow results due to breakdown of endometrial lining of the uterus and its blood vessels which forms liquid that comes out through vagina. Menstruation only occurs if the released ouvm is not fertilised. Lack of menstruation may be indicative of pregnancy. However, it may also be caused due to some other underlying causes like stress, poor health etc. The menstrual phase is followed by the follicular phase.

During this phase, the primary follicles in the ovary grow to become a fully mature Graafian follicle and simultaneously the endometrium of uterus regenerates through proliferation. These changes in the ovary and the uterus are induced by changes in the levels of pituitary and ovarian hormones. The secretion of gonadotropins (LH and FSH) increases gradually during the follicular phase, and stimulates follicular development as well as secretion of estrogens by the growing follicles. Both LH and FSH attain a peak level in the middle of cycle (about 14th day). Rapid secretion of LH leading to its maximum level during the mid-cycle called LH surge induces rupture of Graafian follicle and thereby the release of ovum (ovulation). The ovulation (ovulatory phase) is followed by the luteal phase during which the remaining parts of the Graafian follicle transform as the corpus luteum.

The corpus luteum secretes large amounts of progesterone which is essential for maintenance of the endometrium. Such an endometrium is necessary for implantation of the fertilised ovum and other events of pregnancy. During pregnanacy, all events of the menstrual cycle stop and there is no menstruation. In the absence of fertilisation, the corpus luteum degenerates. This causes disintegration of the endometrium leading to menstruation, marking a new cycle. In human beings, menstrual cycles cease around 50 years of age; that is termed as menopause. Cyclic menstruation is an indicator of normal

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reproductive phase and extends between menarche and menopause.

(i) What causes menstrual flow?

(ii) Why secretory phase is also known as luteal phase?

(iii) What happen if LH secreted rapidly?

(iv) Which of the hormone has no role in menstruation?

Ans :

(i) Menstrual flow occur due to lack of Progesterone.

(ii) Secretory phase is also called luteal phase because during this phase remained part of graafian follicle transform as the corpus luteum.

(iii) Rapid secretion of LH (Luteinizing Hormone) leading to its maximum level during the mid-cycle called LH surge induces rupture of graafian follicle and there by the release of ovum.

(iv) TSH (Thyroid stimulating Hormones) has no role in menstruation.

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201. In the female we productive organ/gonad called Ovary the Ovum is matures. The production of eggs in females begins before birth. But it gets completed only after ferticisation. It under goes following different phases as :

(a) Multiplication phase

(b) Growth phase

(c) Maturation phase

(i) How may primary follicles are left in each Ovary on reaching puberty ?

(ii) What happens during maturation phase of Oogenesis fill production of secondary Oocyte.

Ans :

(i) At reaching puberty only 60,000-80,000 primary follicles are left in each ovary in females.

(ii) During this phase, the secondary follicle transforms into tertiary follicle. These are characterised by a fluid filled cality called antrum. The primary Oocyte in tertiary follicle grown in size and then completes its meiotic diuisim producing two daughter h nuclei in which larger haploid cell is called secondary ooeyte.

CHAPTER 3

REPRODUCTIVE HEALTH

SUMMARY

1. REPRODUCTIVE HEALTH - PROBLEMS AND STRATEGIES

Reproductive health means a total well-being in all aspects of reproduction, i.e., physical, emotional, behavioural and social.

Problems

1. There is little knowledge of personal hygiene and hygiene of reproductive organs. This causes sexually transmitted diseases (STDs).
2. Early marriages lead to high maternal and infant mortality rates.
3. Due to lack of awareness, there has been a rapid increase in population size.
4. People encourage beliefs in myths and misconceptions about sex-related issues.

Strategies

1. Family planning programmes were initiated as early as 1951.
2. Reproductive and Child Health Care (RHC) programmes were launched in 1997 for:
   (a) Creating awareness among people about various reproduction related aspects.
   (b) Providing facilities and support for building up a reproductively healthy society.

2. POPULATION EXPLOSION

The tremendous increase in size and growth rate of population is called population explosion. The world population was about 2 billion in 1900 and it was 6 billion in 2000. Population of India at the time of Independence was about 350 million and it crossed 1 billion in May 2000.

2.1 Reasons for High Population Growth

Reasons for high population growth area as follows :

1. Rapid decline in death rate.
2. Decline in maternal mortality rate (MMR).
3. Decline in infant mortality rate (IMR).
4. Increase in number of people in reproductive age.

2.2 Steps to Curb Population Growth

Step to curb population growth area as follows :

1. Raising marriageable age of girls to 18 years and of boys to 21 years.
2. Incentives should be given to couples with small family.

3. BIRTH CONTROL

The most important step to control population growth is to motivate smaller families by using various contraceptive methods.

3.1 Methods of Birth Control

The contraceptive methods are divided into following categories:

1. **Natural Methods :** These are natural methods that work on the principle of avoiding the meeting of ovum and sperm.
   (a) **Periodic Abstinence :** Periodic abstinence is a method in which a couple avoids or abstains from coitus from day 10-17 of the menstrual cycle, when ovulation is expected to occur.
   (b) **Coitus Interruptus :** Coitus interruptus or withdrawal is a method in which male partner withdraws his penis from the vagina just before ejaculation so as to avoid insemination.
   (c) **Lactational Amenorrhea :** Lactational amenorrhea is based on the principle that during the period of lactation after parturition, ovulation does not occur.
2. **Barrier Methods :**
   (a) **Condoms :**
   (b) **Diaphragms, Cervical Caps and Vaults :**
   (c) **Spermicidal Creams, Jellies and Foams :**

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3. **Intra Uterine Devices (IUDs) :** These devices are inserted by doctors in the uterus through vagina. There are three types of IUDs available:
   (a) **Non-medicated IUDs :**
   (b) **Copper Releasing IUDs :**
   (c) **Hormone Releasing IUDs :**
4. **Oral Contraceptive :** This involves uptake of hormonal preparations of either progestogens or progestogenestrogen combinations in the form of **pills** by females. They inhibit ovulation and implantation as well as alter the quality of cervical mucus to prevent entry of sperms.

   Saheli, an oral contraceptive for females containing a non-steroidal preparation was developed by scientists at Central Drug Research Institute (CDRI) in Lucknow. Pills have high contraceptive value and few side effects.
5. **Injections and Implants :** Progestogens or progestogen-estrogen combination can also be used by females as injections or implants under the skin. Their mode of action is similar to that of pills but their effective periods are longer.
6. **Surgical Methods (Sterilisation) :** These are terminal and permanent methods which block the transport of gametes, thereby preventing conception.

   In males, a small part of the vas deferens is removed and tied up through a small incision on the scrotum. This is called **vasectomy**.

   In females, a small part of the fallopian tube is removed and tied up through a small incision in the abdomen or vagina. This is called **tubectomy**.

4. MEDICAL TERMINATION OF PREGNANCY (MTP)

It is defined as intentional or voluntary termination of pregnancy before full term. MTP was legalised by Government of India in 1971 under strict conditions to avoid misuse.

MTP is done in the following situations:

1. Failure of contraceptive used during coitus or rapes.
2. When continued pregnancy is harmful or fatal to either mother or foetus or both.

It is safe during first trimester, i.e., up to 12 weeks of pregnancy.

5. SEXUALLY TRANSMITTED DISEASES (STDS)

Infections or diseases that are transmitted through sexual intercourse are collectively called sexually transmitted diseases (STDs) or venereal diseases (VD) or reproductive tract infections (RTI). These include gonorrhoea, syphilis, genital herpes, chlamydiasis, genital warts, trichomoniasis, hepatitis-B, HIV.

6. INFERTILITY

It is the inability to produce children in spite of unprotected sexual cohabitation. The reasons of infertility could be physical, congenital diseases, drugs, immunological or even psychological.

The infertile couples could be assisted to have children through certain special techniques called assisted reproductive technologies (ART), which are given below.

1. **Test Tube Baby Programmes :** In this method, ova from the wife/donor (female) and the sperms from the husband/donor (male) are collected and induced to form zygote under simulated conditions in the laboratory. This process is called **in vitro fertilisation** (IVF).

   There is two modern types of IVF
   (a) ZIFT
   (b) IUT
2. **Gamete Intra Fallopian Transfer (GIFT) :** It is the transfer of an ovum collected from a donor into the fallopian tube of another female who cannot produce one, but can provide suitable environment for fertilisation and further development of the embryo.
3. **Intra Cytoplasmic Sperm Injection (ICSI)** : It is a procedure to form an embryo in the laboratory by directly injecting the sperm into an ovum.
4. **Artificial Insemination (AI)**
   (a) In this method, the semen collected either from the husband or a healthy donor is artificially introduced into the vagina or into the uterus (intra uterine insemination or IUI).
   (b) This technique is used in cases where the male is unable to inseminate sperms in the female reproductive tract or due to very low sperm counts in the ejaculation.

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OBJECTIVE QUESTIONS

1. The main reason for making Copper T most effective and popular Intra Uterine device in female:
(a) Reduction in fertilization ability of spermatozoa
(b) Increased phagocytosis of spermatozoa due to release of copper ion
(c) Reduction in motility of spermatozoa
(d) All of these

Ans : OD 2024, 2018
Copper T is a tiny device in the shape of '*T*' which is made of plastic and dropped in copper. It prevents fertilisation in two ways. First the copper ions in the IUD kills the sperm mobility by actings as spermicide. Second, it hinders the ability of the egg to implant into the womb.
Thus (c) is correct option.

2. Population explosion result in:
(a) Reduction in Income
(b) Reduction in land
(c) Reduction in Mineral
(d) All of these

Ans : OD 2017
Asudden, large increase in size of population is called as population explosion. It has negative impact on environment and economy of country.
Thus (d) is correct option.

3. Semen is frozen in
(a) liquid nitrogen (b) refrigerator
(c) ice (d) all of these

Ans : OD 2015
Semen is preserved in liquid nitrogen. It can be stored for as long as 24 years. It can be used for sperm donation or for preserving fertility of men undergoing vasectomy or treatments that may compromise their fertility such as chemotherapy.
Thus (a) is correct option.

4. Sexually transmitted disease is
(a) measles (b) T.B.
(c) gonorrhoea (d) typhoid

Ans : OD 2015
Gonorrhoea is a sexually transmitted disease caused by bacterium neisseria gonorrhoea. It mostly infect warm and moist area of the body like vagina, urethra, eyes, throat etc.
Thus (c) is correct option.

5. Copper-T prevents:
(a) Fertilization (b) Implantation
(c) Ovulation (d) Ejaculation

Ans : OD 2013
Copper-T makes uterus unsuitable for implantation of embryo.
Thus (b) is correct option.

6. The contraceptive Saheli
(a) blocks estrogen receptors in the uterus, preventing eggs from getting implanted.
(b) increases the concentration of estrogen and prevents ovulation in females.
(c) is an IUD.
(d) is a post-coital contraceptive

Ans : COMP 2012
Saheli is a mini pill that contains a non-steroidal preparation called centchroman which is taken once in a week after an initial intake of twice a week dose for 3 months. It blocks estrogen receptors in the uterus hence alters uterine lining and prevents fertilized egg from being implanted.
Thus (a) is correct option.

7. The function of copper ions in copper releasing IUDs is
(a) they inhibit gametogenesis.
(b) they make uterus unsuitable for implantation.
(c) they inhibit ovulation.
(d) they suppress sperm motility and fertilising capacity of sperms.

Ans : DELHI 2005
Copper releasing IUDs (i.e., CuT, LNG-20) are placed in the uterus of the females. They are efficient birth control methods. Copper ions released by them suppress motility and fertilizing capacity of the sperms.
Thus (d) is correct option.

8. Which of the following is incorrect regarding vasectomy?
(a) no sperm occurs in seminal fluid
(b) no sperm occurs in epididymis
(c) vasa deferentia is cut and ited
(d) irreversible sterility

Ans : OD 2024, 2007
Vasectomy is a surgical contraception method performed in males. In vasectomy, a small part of the vas deferens is removed or tied up through a small cut on the scrotum. This prevents sperm transport. Vasectomy has a poor reversibility. There is no effect on libido and erectile functioning. Seminal vesicles are one pair

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of sac like structures which join vasa deferentia to form ejaculatory duct. They secrete seminal fluid which contains fructose, prostaglandins and clotting protein, but no sperms. In a male who has undergone vasectomy, the ejaculatory duct will receive seminal fluid but due to cut in vasa deferentia sperms will not be transported from epididymis hence the semen will lack sperms.
Thus (b) is correct option.

9. Embryo with more than 16 blastomeres formed due to in vitro fertilisation is transferred into
(a) uterus (b) fallopian tube
(c) fimbriae (d) cervix

Ans : **DELHI 2009**

Embryo with more than 16 blastomeres formed due to in vitro fertilisation is transferred into uterus (intra-uterine transfer, IUT).
Thus (a) is correct option.

10. Which of the following approaches does not give the defined action of contraceptive?
(a) Hormonal contraceptives : Prevent/retard entry of sperms, prevent ovulation and fertilisation
(b) Vasectomy : Prevents spermatogenesis
(c) Barrier methods : Prevent fertilisation
(d) Intra uterine devices : Increase phagocytosis of sperms, motility and fertility capacity of sperms

Ans : **DELHI 2005**

Vasectomy is a sterilisation technique for the males in which a small part of the vas deferens is removed or tied up through a small cut on the scrotum to prevent passage of sperms. Spermatogenesis is the series of cell division in the testis that results in the production of spermatozoa or sperms.
Thus (b) is correct option.

11. In context of amniocentesis, which of the following statements is incorrect?
(a) it can be used for detection of Down's syndrome
(b) it can be used for detection of cleft palate
(c) it is usually done when a woman is between 14-16 weeks pregnant
(d) it is used for prenatal sex determination

Ans : **SQP 2016**

Amniocentesis is fetal sex determination and disorder test based on the chromosomal pattern in the amniotic fluid surrounding the developing embryo. It can be used to determine the sex of the infant, to identify some abnormalities in the number of chromosomes and to detect certain biochemicals and enzymatic abnormalities. It is usually done when woman is 14-16 weeks pregnant. Cleft palate can be detected by ultrasound.
Thus (b) is correct option.

12. A childless couple can be assisted to have a child through a technique called GIFT. The full form of this technique is
(a) gamete internal fertilisation and transfer
(b) germ cell internal fallopian transfer
(c) gamete inseminated fallopian transfer
(d) gamete intra fallopian transfer

Ans : **FOREIGN 2013**

Gamete Intra Fallopian Transfer (GIFT) is an assisted reproductive technology in which both the sperm and unfertilized oocytes are transferred into the fallopian tubes. Fertilization takes place in vivo (inside the body of the female).
Thus (d) is correct option.

13. Tubectomy is a method of sterilization in which
(a) small part of the fallopian tube is removed or tied up
(b) ovaries are removed surgically
(c) small part of vas deferens is removed or tied up
(d) uterus is removed surgically

Ans : **COMP 2015**

Sterilization provides a permanent and sure birth control. In females, it is called tubectomy. Tubectomy involves the blockage of the fallopian tubes. A small part of the fallopian tube is removed or tied up through a small incision in the abdomen or through vagina.
Thus (a) is correct option.

14. Which of the following is hormone-releasing IUD?
(a) LNG-20 (b) Multiload 375
(c) Lippes loop (d) Cu7

Ans : **OD 2005**

LNG-20 is the hormone releasing IUD, multiload 375 and Cu7 are copper releasing IUDs and Lippes loops is a non-medicated IUD.
Thus (a) is correct option.

15. Which of the following is a hormone releasing Intra Uterine Device (IUD)?
(a) multiload 375 (b) LNG-20
(c) cervical cap (d) vault

Ans : **OD 2008**

At present the most widely accepted method of contraception in India is IUDs. Intra uterine devices (IUDs) are plastic or metal objects which

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are inserted by doctors in the uterus through vagina. These are available as non-medicated IUDs (i.e., Lippes lopp), copper releasing IUDs (progestasert, LNG-20). Vault cap is hemispheric dome like rubber or plastic cap with a thick rim which is meant for fitting over the vaginal vault over the cervix.
Thus (b) is correct option.

16. Assisted reproductive technology, IVF involves transfer of
(a) ovum into the fallopian tube
(b) zygote into the fallopian tube
(c) zygote into the uterus
(d) embryo with 16 blastomeres into the fallopian tube

Ans : **DELHI 2007**

Assisted reproductive technologies (ART) include a number of special techniques which assist infertile couples to have children. An important technique of ART is test tube baby programme. The baby produced by conceiving in a culture dish and nursing in the uterus is called a test tube baby. This method involves in vitro fertilization (IVF), i.e., fertilization of male and female gamete outside the body in almost similar conditions as that in the body followed by embryo transfer (ET). Zygote or embryo upto 8 blastomeres is transferred into the fallopian tube (ZIFT - Zygota Intra Fallopian Transfer) and mature embryo with more than 8 blastomeres is transferred to uterus to complete its further development.
Thus (b) is correct option.

17. Artificial insemination means
(a) artificial introduction of sperms of a healthy donor into the vagina.
(b) introduction of sperms of a healthy donor directly into the ovary
(c) transfer of sperms of a healthy donor to a test tube containing ova
(d) transfer of sperms of husband to a test tube containing ova

Ans : **SQP 2014**

In artificial insemination technique, the semen of a healthy donor male is collected and is introduced artificially through a flexible polyethylene catheter into the vagina or into uterus called intrauterine insemination (IUI). Best results are obtained when the motile sperm count is more than 10 million. The fertilizing capacity of spermatozoa (sperms) is for 24-28 hours. The procedure may be repeated 2-3 times over a period of 2-3 days.
Thus (a) is correct option.

18. One of the legal methods of birth control is
(a) by having coitus at the time of day break.
(b) by a premature ejaculation during coitus.
(c) abortion by taking an appropriate medicine.
(d) by abstaining from coitus from day 10 to 17 of the menstrual cycle.

Ans : **FOREIGN 2017**

Intentional or voluntary termination of pregnancy by taking an appropriate medicine before full term is called medical termination of pregnancy (MTP) or induced abortion. Nearly 45 to 50 million MTPs are performed in a year all over the world which account to 1/5th of the total number of conceived pregnancies in a year. MTP has a significant role in decreasing the population though it is not meant for that purpose. Government of India legalized MTP in 1971 with some strict conditions to avoid its misuse. Such restrictions are all the more important to check indiscriminate and illegal female foeticides.
Thus (c) is correct option.

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19. The stage transferred into the uterus after induced fertilization of ovum in the laboratory is
(a) embryo at 4 blastomeres stage
(b) embryo at 2 blastmoeres stage
(c) morula
(d) zygote

Ans : **COMP 2019**

Cleavage divisions produce a solid ball of cells called morula. It has 8-16 cells, occasionally 32 cells. It is transferred into uterus (IUT-Intra-uterine transfer) for further development.
Thus (c) is correct option.

20. One of the following is not a method of contraception. Which one?
(a) condoms
(b) pills of a combination of oxytocin and vasopressin.
(c) lippes loop
(d) tubectomy

Ans : **DELHI 2005**

Oxytocin is a birth hormone and vasopressin (anti-diuretic hormone) reabsorbs water from the renal tubles to conserve water in the body. They have no role in contraception.
Thus (b) is correct option.

21. The test-tube baby programme employs which one of the following techniques?
(a) intra cytoplasmic sperm injection (ICSI)
(b) intra uterine insemination (IUI)
(c) gamete intra fallopian transfer (GIFT)

(d) zygote intra fallopian transfer (ZIFT)

Ans : **OD 2021**

Assisted reproductive technologies (ART) include a number of special techniques which assist infertile couples to have children. An important technique of ART is test tube baby programme. The baby produced by conceiving in a culture dish and nursing in the uterus is called a test tube baby. This method involves in vitro fertilization (IVF), i.e., fertilization of male and female gamete outside the body in almost similar conditions as that in the body followed by embryo transfer (ET). Zygote or embryo upto 8 blastomeres is transferred into the fallopian tube (ZIFT - Zygota Intra Fallopian Transfer) and mature embryo with more than 8 blastomeres is transferred to uterus to complete its further development.
Thus (d) is correct option.

22. Which one of the following is the most widely accepted method of contraception in India at present?
(a) cervical caps
(b) tubectomy
(c) diaphragms
(d) IUDs (intra uterine devices)

Ans : **DELHI 2009**

At present the most widely accepted method of contraception in India is IUDs. These Intra Uterine Devices (IUDs) are presently available as the nonmedicated IUDs (e.g. lippes loop), copper releasing IUDs (CuT, Cu7, Multiload 375) and the hormones releasing IUDs (Progestasert, LNG-20). IUDs increase phagocytosis of sperms within the uterus and the Cu-ions released suppress sperm motility and the fertilizing capacity of sperms. The hormone releasing IUDs make the uterus unsuitable for implantation and cervix hostile to the sperms.
Thus (d) is correct option.

23. Medical termination of pregnancy (MTP) is considered safe up to how many weeks of pregnancy?
(a) eight weeks (b) twelve weeks
(c) eighteen weeks (d) six weeks

Ans : **OD 2005**

Medical termination of pregnancy (MTP) or abortion is the termination of pregnancy before the foetus becomes viable. MTP is comparatively safe upto 12 weeks (the first trimester) of pregnancy. It becomes more risky after the first trimester period of pregnancy as the foetus becomes intimately associated with the maternal tissues.
Thus (b) is correct option.

24. The technique called Gamete Intra Fallopian Transfer (GIFT) is recommended for those females
(a) who cannot produce an ovum.
(b) who cannot retain the foetus inside uterus
(c) whose cervical canal is too narrow to allow passage for the sperms
(d) who cannot provide suitable environment for fertilization

Ans : **SQP 2006**

Gamete Intra Fallopian Transfer (GIFT) is transfer of an ovum collected from a donor into the fallopian tube of another female who cannot produce ova but can provide proper environment for fertilization and further development.
Thus (a) is correct option.

25. The permissible use of the technique amniocentesis is for
(a) detecting sex of the unborn foetus
(b) artificial insemination
(c) transfer of embryo into the uterus of a surrogate mother
(d) detecting any genetic abnormality

Ans : **DELHI 2005**

Amniocentesis is withdrawal of a sample of the fluid (amniotic fluid) surrounding a foetus in the uterus by piercing the amniotic sac through the abdominal wall, under direct ultrasound guidance. AS the amniotic fluid contains cells from the foetus, cell cultures enable chromosome patterns to be studied so that prenatal diagnosis of chromosomal abnormalities can be made. Certain metabolic errors and other abnormalities, such as spina bifida, can also be diagnosed prenatally from analysis of the cells or of the fluid.

As this technique also helps in detection of sex of the unborn foetus, it has been banned in order to legally check increasing female foeticide.
Thus (d) is correct option.

26. Cu ions released from copper-releasing intra uterine devices (IUDs)
(a) make uterus unsuitable for implantation
(b) increase phagocytosis of sperms
(c) suppress sperm motility
(d) prevent ovulation

Ans : **FOREIGN 2010**

Copper releasing IUDs (i.e., CuT, LNG-20) are placed in the uterus of the females. They are efficient birth control methods. Copper ions released by them suppress motility and fertilizing

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capacity of the sperms.
Thus (c) is correct option.

27. The formula for exponential population growth is
(a) $dN/dt = rN$ (b) $dt/dN = rN$
(c) $dN/rN = dt$ (d) $rN/dN = dt$

Ans : COMP 2015

Nearly all populations will tend to grow exponentially as long as there are resources available. The formula for exponential population growth is $dN/dt = rN$. In this equation d is the rate of change, N is the number of existing individuals, r is the intrinsic growth rate, t is time, and dN/dt is the rate of change in population size.
Thus (a) is correct option.

28. Test tube baby means a baby born when
(a) it is developed in a test tube
(b) it is developed through tissue culture method
(c) the ovum is fertilized externally and thereafter implanted in the uterus.
(d) it develops from a non-fertilized uterus

Ans : SQP 2005

By in vitro fertilization, the ovum is fertilized with sperm outside the body of a woman, providing the ovum with the same environmental conditions as it would have got inside the uterus. The zygote is grown inside a culture and when embryo is formed, it is then implanted into uterus where it develops into foetus and then into a child. This is called test tube baby.
Thus (c) is correct option.

29. Two opposite forces operate in the growth and development of every population. One of them is related to the ability to reproduce at a given rate. The force opposite to it is called
(a) fecundity
(b) environmental resistances
(c) biotic control
(d) mortality

Ans : OD 2018

The environmental factors which can check the growth of population size constitute the environmental resistance. These include predators, food, water, nesting sites, similar competitors, etc. All living things tend to reproduce until the point at which their environment becomes a limiting factor. No population, human or otherwise, can grow indefinitely; eventually, some biotic or abiotic variable will begin to limit population growth.
Thus (b) is correct option.

30. In a population, unrestricted reproductive capacity is called as
(a) biotic potential (b) fertility rate
(c) carrying capacity (d) birth rate

Ans : DELHI 2020

Biotic potential is defined as the physiological capacity of organisms to produce their offspring under natural conditions. It is also called reproductive potential. In nature, the biotic potential of organisms is enormous but all the organisms do not survive due to the lack of food and space. There are also a number of diseases and the predatory organisms, that feed upon other organisms. The carrying capacity is the maximum number of individuals which the environment can support or sustain.
Thus (a) is correct option.

31. What is the work of progesterone which is present in oral contraceptive pills?
(a) to inhibit ovulation
(b) to check oogenesis
(c) to check entry of sperms into cervix and to make them inactive
(d) to check sexual behaviour

Ans : SQP 2009

Pills also called contraceptive pills contain small does of either progestogens or progestogen-oestrogen combinations. They, inhibit ovulation and implantation.
Thus (a) is correct option.

32. Tablets to prevent male contraception contain
(a) progesterone (b) LH
(c) FSH (d) both b and c

Ans : FOREIGN 2015

Male contraceptives work by interfering with sperm production or delivery, that means they inhibit the spermatogenesis as well as the function of male sex hormone testosterone.

LH and FSH (both called gonadotropic hormone are secreted from anterior pituitary) have specific functions in the testis. FSH stimulates male germ cells for spermatogenesis and LH stimulates accessory cells, called leydig cells to produce sex steroids, especially testosterone. Thus, these two hormones (FSH and LH) prevent male contraception.
Thus (d) is correct option.

33. The most important component of the oral contraceptive pills is
(a) Thyroxine
(b) Luteinizing hormone

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(c) Progesterone
(d) Growth hormone

Ans : COMP 2016

The most common type of pill is the so called **combined pill**. It contains a combination of synthetic progestins (acting like progesterone) and estrogen. Combined pills inhibit ovulation by inhibiting the normal release of FSH and LH from the pituitary. They mimic the hormones produced by the corpus luteum, causing the uterine walls to thicken, as during normal menstrual cycle, and suppressing the release of FSH and LH.
Thus (c) is correct option.

34. The present population of the world is about
(a) 15 trillion (b) 6 billion
(c) 500 million (d) 100 million

Ans : OD 2018

As this question appeared in 1997, so the population of world in mid 1997 was 5, 840, 324, 240 i.e., approximately 6 billion.
Thus (b) is correct option.

35. Foetal sex can be determined by examining cells from the amniotic fluid by looking for
(a) chiasmata (b) kinetochore
(c) barr bodies (d) autosomes

Ans : SQP 2005

Barr body is a structure consisting of a condensed X chromosome that is found in non-dividing nuclei of female mammals. Amniotic fluid contains foetal skin cells, that are stained to determine the presence of sex chromatin (barr body). The presence of barr body indicates that the developing foetus is female with two X-chromosome.
Thus (c) is correct option.

36. The test tube baby means
(a) fertilization and development both in uterus.
(b) fertilization in vitro and then transplantation in uterus.
(c) a baby grown in test tube.
(d) fertilized and developed embryo in test cube.

Ans : SQP 2013

By in vitro fertilization, the ovum is fertilized with sperm outside the body of a woman, providing the ovum with the same environmental conditions as it would have got inside the uterus. The zygote is grown inside a culture and when embryo is formed, it is then implanted into uterus where it develops into foetus and then into a child. This is called test tube baby.
Thus (b) is correct option.

37. In India, human population is heavily weighed towards the younger age groups as a result of
(a) short life span of many individuals and high birth rate.
(b) long life span of many individuals and high birth rate.
(c) short life span of many individuals and low birth rate.
(d) long life span of many individuals and low birth rate.

Ans : DELHI 2008

A population having mostly younger age group means its birth rate is high. If death rate is increased then the proportion of old age group will be increased. But in this case death rate has increasing trend thence in a human population which is heavily weighted towards the younger age groups, there will be short life span and high birth rate.
Thus (a) is correct option.

38. Which of the following statements is correct with reference to a test tube baby?
(a) fertilization of the egg is effected outside the body; the fertilized egg is then placed in the womb of the mother where the gestation is completed.
(b) fertilization of the egg is effected in the female genital tract. It is then taken out and grown in a large test tube.
(c) a prematurely born baby is reared in an incubator.
(d) fertilization of the egg and growth of the embryo are affected in a large test tube.

Ans : SQP 2005

By in vitro fertilization, the ovum is fertilized with sperm outside the body of a woman, providing the ovum with the same environmental conditions as it would have got inside the uterus. The zygote is grown inside a culture and when embryo is formed, it is then implanted into uterus where it develops into foetus and then into a child. This is called test tube baby.
Thus (a) is correct option.

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ASSERTION AND REASON

DIRECTION : Each of these questions contains as Assertion following by Reason. Read them carefully and answer the question on the basis of following options. You have to select the one that best describes the two statements.

39. Assertion : Cu-T and Cu-7 do not suppresses sperm-motility.
Reason : Hormones released by them affect sperm motility.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **FOREIGN 2020**
Cu-7 and Cu-T are intrauterine contraceptive devices for females. They do not suppress sperm motility. Their mode of action is different. Cu-T and Cu-7 discharge 50-75 micrograms of ionic copper into the uterus daily. These copper ions interfere with life-sustaining functions that regulate implantation in the uterus. No any hormone is released by them.
Thus (c) is correct option.

40. Assertion : HIV infection can be avoided by use of condoms.
Reason : Condoms secrete anti-viral interferons.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **SQP 2005**
The use of condoms has been shown to decrease the transmission of AIDS because condoms is contraceptic.
Thus (c) is correct option.

41. Assertion : Copper-T is an effective contraceptive device in human females.
Reason : Copper-T prevents passage of sperms from vagina upwards into fallopian tubes.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **DELHI 2009**
Intra-uterine device (IUD) Copper-T is plastic or metal object placed in the uterus by a doctor. Copper-T prevent the fertilization of the egg or implantation of the embryo.
Thus (c) is correct option.

VERY SHORT ANSWER QUESTIONS

42. Reproductive health refers only to healthy reproductive functions. Comment.

Ans : **OD 2005**
No, reproductive health refers to the total well-being in all aspects of reproduction, i.e. physical, emotional, psychological and social.

43. Mention one positive and one negative application of amniocentesis.

Ans : **DELHI 2010**
Positive application It is a medical procedure used in prenatal diagnosis of chromosomal abnormalities, foetal infections, etc.
Negative application It leads to female foeticide in gender biased communities.

44. What are the suggested reasons for the population explosion?

Ans : **COMP 2010**
(i) Rapid decline in the overall death rate because of better medical facilities.
(ii) Increase in number of people in reproducible age.

45. How does Cu-7, Multiload 375 and progestasert, LNG-20 differ in contraceptive action?

Ans : **SQP 2005**
Cu-7 and Multiload 375 are copper releasing IUDs containing copper ions, whereas progestasert and LNG-20 are hormone releasing IUDs.

46. Name an IUD that you would recommend to promote the cervix hostility to sperms.

Ans : **DELHI 2014**
The hormone releasing IUD's, e.g. progestasert, LNG-20 are recommended to promote the cervix hostility to sperms.

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47. How can pregnancy due to rape or casual unprotected intercourse be prevented?

Ans : **DELHI 2010**

By using emergency contraceptives, e.g. i-pill.

48. How do hormonal pills work as contraceptives?

Ans :

An oral pill prevents pregnancy in the following ways

(i) It inhibits ovulation and implantation.

(ii) It alters the quality of cervical mucus and retards the entry of sperms into cervix.

49. Name the contraceptive recently developed at CDRI, Lucknow.

Ans : **OD 2024, 2009**

Saheli is an once a week oral contraceptive developed at CDRI, Lucknow.

50. Our government has intentionally imposed strict conditions for MTP in our country. Justify giving a reason.

Ans : **DELHI 2017**

MTP or induced abortion is termination of pregnancy due to certain medical reasons. Government of India legalised MTP in 1971 with strict conditions to avoid its misuse, i.e. to check indiscriminat and illegal female foeticides.

51. What are STDs? Write its full form and the other names given to them.

Ans : **SQP 2020**

STDs are sexually transmitted disease. Also called venereal or Reproductive Tract Infections.

52. Which age group is more vulnerable to STDs?

Ans : **FOREIGN 2017**

Persons in the age group of 15-24 years are highly vulnerable to STDs.

53. Mention early symptoms of STDs.

Ans : **SQP 2005**

Early symptoms of STDs include itching, fluid discharge, slight pain and swelling in the genital region.

54. Give the name of the STD, which can be transmitted through contaminated blood.

Ans : **DELHI 2014**

AIDS (Acquired Immuno Deficiency Syndrome).

55. State the statement given below as true/false with explanation.

Infertility is defined as the inability to produce a viable offspring and is always due to abnormalities/ defects in the female partner.

Ans : **COMP 2014**

False, often female is blamed for the couple being childless, but more often the problem lies in male partner.

56. Give some reasons for infertility among young couples.

Ans : **OD 2013**

Drugs, congenital diseases, smoking, etc.

57. What is the method of directly injecting a sperm into ovum called as?

Ans : **DELHI 2017**

Intra Cytoplasmic Sperm Injection (ICSI).

58. Mention some of the important attributes of reproductive health of a society.

Ans : **OD 2005**

Reproductive health means a total well-being in all aspects of reproduction in physical, emotional, behavioural and social.

59. List out the consequences of population explosion.

Ans : **FOREIGN 2007**

Unemployment and shortage of food.

60. Which principle lies behind the natural method of birth control?

Ans : **COMP 2005**

Natural method works on the principle of avoiding chances of ovum and sperm meeting.

61. Why is tubectomy considered a contraceptive method?

Ans : **OD 2010**

In tubectomy, a small part of the Fallopian tube is cut and tied up. This prevents egg to reach Fallopian tube thus, help in contraception.

62. Name the complication that arises due to late detection of STDs.

Ans : **SQP 2013**

Late detection of STDs leads to infertility and often death.

63. Give two reasons why a person infected with a venereal disease does not go for timely detection and treatment of it.

Ans : **FOREIGN 2017**

Two reasons are

(i) Absence of significant symptoms at earlier stage.

(ii) Social stigma attached to the STDs.

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SHORT ANSWER QUESTIONS

64. What is test tube baby ?

Ans : OD 2017

The babies that are conceived through in vitro fertilisation (IVF) technique are called as test tube baby. IVF is a technique of assisted reproductive technology (ART) in which egg or ovum are artificial fertilised by sperm outside the woman's body in a laboratory conditions and later transferred back into the woman's body at certain stage of growth (8-16 celled) with the intent to establish a successful pregnancy.

Initially, this method was developed to overcome infertility due to the problems of fallopian tube but afterward this technique is also implied in case of endometriosis, pelvic inflammatory disease, cervical mucus problems, failed conventional fertility methods etc.

In India, the first test tube baby was kumari Harsha, born on August 6, 1986 at KEM Hospital Mumbai under supervision of Dr. Indira Hinduja

65. Write any four sexually transmitted diseases with their causative pathogens.

Ans : COMP 2005

Sexually Transmitted Diseases (STDS) are those diseases that are transmitted through copulation or sexual intercourse. Few examples of (STDS) are as follows:

1 **Syphilis :** It is caused by bacterium treponema pallidum symptoms are inflammation of mucous membrane of genital tract, rectum, buccal cavity and lesions on skin.

2 **Genital herpes :** It is caused by virus called Herpes simplex. It is incurable. It produces painful blisters on perpuel, glams and penis in males and vulva and vagina in females.

3 **Gonorrhoea :** It is caused by bacterium Neisseria gonorrhoeal. This disease mainly affects women. Symptoms are harrowing sensation in urethra, painful urination, inflammation of rectum, throat and eyes.

4 **AIDS (Acquired Immunodeficiency Syndrome) :** It is caused by Human Immunodeficiency Virus (HIV). This virus destroys the human immune system so that the body fails to produce antibodies against infection.

66. What is sterilization? Explain methods of sterilization.

Ans : OD 2017

Sterilization is a permanent method of contraception used by male or female partner to prevent any more pregnancy. It is a surgical method in which transport of gametes to the copulatory organs are blocked forever. It is very reliable, simple method with no side effect on health. It can be performed on both male and females.

1 **Vasectomy :** Surgical sterilization of males is called as vasectomy. In it, a small part of vas deferens is removed Or tied up through a small incision on scrotum. Thus, hindering the transport of sperms to the penis during copulation. It has no side effect on sexual vigour of males.

2 **Tubectomy :** Surgical sterilization of females is called as tubectomy. In it, a small part of fallopian tube is removed on tied up through a small incision in the abdomen Or through vagina. This results in availability of ovum or egg in fallopian tube for fertilisation.

67. Write a short note on infertility.

Ans : OD 2016

Infertility is the inability to full fill pregnancy after reasonable time of sexual intercourse with no contraceptive measure taken Generally, it is of two types.

1. **Primary infertility :** It is the case where a couple never had children
2. **Secondary infertility :** In this case, couples already have children but they are unable to conceive next time. It is more common than primary infertility.

   The infertility could be due to problem/ defect in female as well as in male partner. The common causes of infertility in males are low sperm count, or semen quality, sexual dysfunction, azoospermia etc. while in females this problem occurs due to age related factors, uterine problems, damaged fallopian tubes, block age of fallopian tube, polycystic ovarian syndrome etc.

   Many advance medical facilities are now being available for treatment of such problem. eg. IUF, ICSI, ZIFT etc.

68. What is M.T.P ? Write its safety and fatal periods.

Ans : OD 2013

Voluntary termination of pregnancy before full term is called MTP (medical termination of pregnancy) or induced abortion. In India, MTP, is legalized in 1971 with some restriction to prevent its misuse such as indiscriminate and illegal female foeticides. MTP is used to get rid of unwanted pregnancy due to unprotected intercourse or failure of contraceptives used during coitus or

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rapes. When pregnancy continuation could be harmful or even fatal to mother or foetus. MTPs are considered relatively safe during first trimester or up to 12 weeks of pregnancy. Second trimester MTPs are much more riskier.

69. What is amniocentesis ?

Ans : **COMP 2005**

Amniocentesis is a prenatal test in which a small amount of amniotic fluid is removed from the sac surrounding the fetus for testing. It is done with the help of a fine needle which is inserted into the uterus through the abdomen, under ultrasound guidance. The fluid is then sent to a laboratory for analysis. Amniocentesis can be done for various reasons.

1. **Genetic testing-** Genetic amniocentesis is performed to diagnose certain conditions, such as Down syndrome.
2. **Fetal lung testing-** It helps to determine whether the baby's lungs are mature enough for birth.
3. **Diagnosis of fetal infection-** Occasionally, amniocentesis is used to evaluate a baby for infection or other illness. The procedure also can be done to evaluate the severity of anemia in babies who have Rh sensitization.

70. What do you think is the significance of reproductive health in a society ?

Ans : **DELHI 2016**

Reproductive health refers to a total well being in all aspects of reproduction i.e., physical, emotional, behavioural and social.

A reproductively healthy society can solve all the problems of a nation such as population explosion, sex abuse, sec related crimes, unhygienic conditions and standard living condition. Therefore, for a healthy society, it is important to maintain reproductive health.

71. Explain how do the following act as contraceptives:

1. Cu-T
2. Saheli

Ans : **SQP 2015**

1. **Cu-T :** Cu-T is an intrauterine device used as a contraceptive. It releases Cu^{++} ions which suppress sperm motility, thereby preventing the fertilisation of the ovum.
2. **Saheli :** Saheli is a new oral pill used once a week. It is a steroid preparation with very less side effects and high contraceptive value. It is a hormonal preparation (Progestogens and estrogens) which inhibit ovulation and implantation.

72. Why is Saheli considered an effective contraceptive for women to space children?

Ans : **FOREIGN 2019**

Hormonal preparations (progestogens or progestogens and estrogen) inhibit ovulation and implantation. Saheli, a new oral pill is used once-a-weak, a steroid preparation with very less side effects and high contraceptive value developed by CDRI, in Lucknow, India.

73. Why is ZIFT a boon to childless couples? Explain the procedure.

Ans : **COMP 2020**

ZIFT (zygote intra-fallopian transfer) is a part of test-tube baby programme. It is performed specially where the male partner is infertile. The egg is extracted from female and is in-vitro fertilized by the sperms of husband/donor. The zygote is made to develop into embryo. When the embryos are at 8-celled blastomere stage, are transferred into fallopian tube for further development.

NODIA

74. List various artificial birth control measures.

Ans : **OD 2023**

1. Use of contraceptives such as condom, diaphragm, cervical cap, IUDs and oral pills and vaginal tablets, jellies, pastes and creams, (Prevent contact of sperms and eggs).
2. Surgical operation, namely vasectomy and tubectomy (tubal ligation).
3. Abortion (MTP).

75. Write short note on RCH programmes.

Ans : **DELHI 2021**

RCH (reproductive and child health care) programmes through health centers provide:

1. Necessary and right information, guidance and help to the mothers before and after delivery so that they can properly look after themselves and the infants.
2. Ensures safe delivery of infant and postnatal care.
3. Provides for immunization of infants and prophylaxis against anaemia and vitamin deficiency.
4. Arranges milk feeding programmers.
5. Training midwives.
6. Educating fertile couples about the benefits of small family.

76. Who is a surrogate mother ?

Ans : **COMP 2005**

A surrogate mother is a mother who substitutes

the real mother to nurse the embryo in her uterus/ womb because some women can produce normal ovum but cannot support a full term pregnancy due to physiological and anatomical reasons. Thus, an in-vitro embryo is implanted into the womb of another women who carries it for the full term of pregnancy and give birth to a healthy baby.

77. What are permanent methods for contraception?

Ans : **SQP 2010**

Sterilization is a permanent and sure method for contraception. It is done by cutting and ligating vas deferens (vasectomy) in males and cutting and ligating fallopian tubes (tubectomy) in females. These methods do not interfere the normal healthy life of the individuals. They block the transport of gametes to avoid fertilization.

78. Name two new techniques for determining the condition of the foetus.

Ans : **FOREIGN 2007**

1. Chorionic villus sampling (CVS) sloughed off foetal cells are sucked into a catheter passed through the cervix without injuring the foetus. This provides a mass of rapidly dividing foetal cells for detection of any chromosomal disorders.

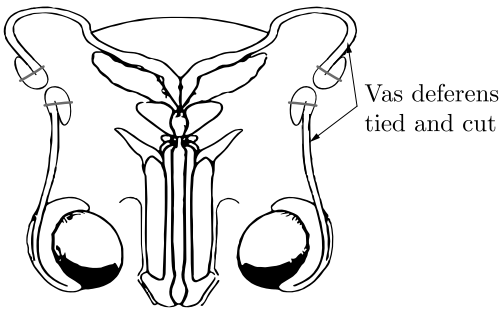

Fig Vasectomy in case of male

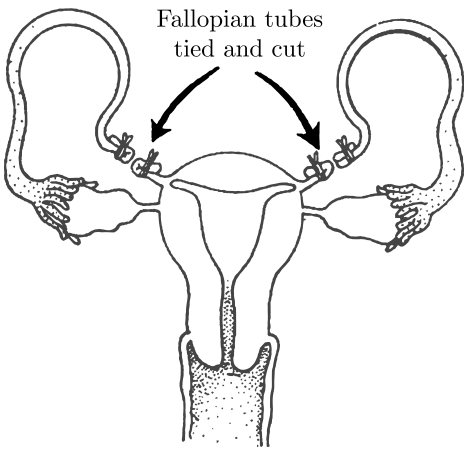

Fig Tubectomy in case of female

2. Ultrasound imaging or sonography technique uses high-frequency sound waves ranging between 1 to 15 MHz frequency. This technique is totally harmless, non-invasive and it does not use any ionic radiations.

79. What are various oral contraceptive used? How do they function? What is the advantage of Saheli?

Ans : **COMP 2005**

Oral administration of small doses of either progestogens or progestogen-estrogen combinations is another contraceptive method used by the females. They are used in the form of tablets and hence are popularly called the **pills**. They inhibit ovulation and implantation as well as alter the quality of cervical mucus to prevent/ retard entry of sperms from vagina. Pills are very effective with lesser side effects and are well accepted by the females.

Advantages of Saheli

Saheli, the new oral contraceptive for the female contains a nonsteroidal preparation called centchroman. It is a **one a weak** pill with very few side effects and high contraceptive value.

Recently a new pill **i-pill** has been introduced by **Cipla** pharmaceuticals to be used within 72 hours of unprotected sex to avoid unwanted and undesired pregnancy.

80. Define reproductive health. How does this affect society?

Ans : **COMP 2013**

Reproductive health means a total well being in all aspects of reproduction i.e., physical, emotional, behavioural and social.

A society with the people having physically and functionally normal reproductive organs and normal emotional and behavioural interaction among them in all sex related aspects is called reproductively healthy society.

81. Briefly give an account of various intra uterine contraceptive measures. What are advantages? How do they function?

Ans : **OD 2005**

The use of IUD is most effective and popular. Different types of IUDs are presently available such as the non-medicated IUDs (e.g., Lippes loop), copper releasing IUDs (CuT, Cu 7, Multiload 375) and the hormone releasing ones (Progestasert, LNG-20).

Functions

IUDs increase phagocytosis of sperms within the uterus and the Cu ions released by some suppress sperm motility and the fertilizing capacity of

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sperms. The hormone releasing IUDs. in addition, make the uterus unsuitable for implantation and the cervix hostile to the sperms.

Advantages

IUDs are ideal contraceptives for the females who want to delay pregnancy and /or space children. It is one of most widely accepted method of contraception in India.

82. Briefly explain IVF and ET. What are the conditions in which these methods are advised?

Ans : **COMP 2005**

IVF and ET refers to in vitro fertilization and embryo transfer. Gametes from the male and female are collected hygienically and induced to fuse in the laboratory setup under simulated conditions. The zygote formed is collected and is introduced into the uterine region of a host or surrogate mother at an appropriate time (secretory phase). These methods are advised when the female has blocked fallopian tubes or the male produce few sperms i.e., oligospermic.

83. List the objectives of Reproductive and child Health Care Programmes (RCH).

Ans : **COMP 2005**

Different objective of RCH are as follow :

1. Creating awareness about various reproduction related problems.
2. Providing facilities and support for building up a reproductively healthy society.
3. Providing audio-visual and print media support to various government and non-government organisations.
4. Educating the people and providing right information and to save them from myths and misconceptions.
5. Providing proper education regarding reproductive organs, adolescence and related changes, safe and hygienic sexual practices.
6. Providing information regarding danger of sexually transmitted diseases, AIDS etc.

84. A mother of one year old daughter wanted to space her second child. Her doctor suggested Cu-T. Explain its contraceptive actions.

Ans : **OD 2007**

Cu-T is intrauterine device. These intrauterine devices are presently available as the non-medicated and their hormone releasing IUDs. It increases phagocytosis of sperms within the uterus and Cu ions released suppress sperms motility and the fertilizing capacity of sperms. It makes the uterus unsuitable for implantation and the cervix hostile to the sperms. It is a ideal contraceptives for females in urban areas.

85. All reproductive tract infections (RTIs) are STDs, but all STDs are not RTIs. Justify with example.

Ans : **FOREIGN 2014**

Among the common STDs-gonorrhoea, syphilis, genital herpes, chlamydiasis, hepatitis-B, AIDs etc., hepatitis-B, and AIDs are not infections of the reproductive organs though their mode of transmission could be through sexual contact also. All other diseases are transmitted through sexual contact and are also infections of the reproductive tract.

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86. Define population density. What are consequences of high population density?

Ans : **COMP 2016**

Population density is the number of individuals of a species per unit area or volume e.g. number of humans/animals per square kilometre; number of trees per acre of a forest etc. If the total number of individuals is represented by letter N and the number of units of space by letter S, the population density D can be obtained as $D = N/S$.

Consequences of Higher Population Density

As the population density increases in a country beyond its carrying capacity; it causes many problems such as:

1. Decrease in per capita income
2. Decrease in availability of natural resources like hand, minerals, wood, fuel, etc.
3. General health goes down.
4. The large population of a country is the result of having large families and the quality of life gets deteriorated accordingly.

87. Suggest the aspects of reproductive health which need to be given special attention in the present scenario.

Ans : **DELHI 2018**

The following aspects of reproductive health need to be given special attention in present scenario:

1. Educating married couples about available birth control options, care of pregnant mothers, postnatal care of mother and child, importance of breast feeding.
2. Equal opportunities for male and female child.
3. Control of human population, preference for small families.
4. Introduction of sex-education.

5. Proper information about safe sex, adolescence related problem, STD, AIDS etc.
6. Different techniques for birth control.
7. Research on various reproduction related areas.

88. Do you think that reproductive health in our country has improved in the past 50 years? If yes, mention some such areas of improvement.

Ans : **OD 2009**

Yes, the reproductive health in our country has greatly changed and improved in the past 50 years. Some such areas of improvement are:

1. Family planning programmes.
2. Large-scale child immunization programme e.g., pulse-polio.
3. Maternity and child health.
4. Increased use of easy and availability of contraceptives.
5. Improved medical facilities available for the treatment of diseases.
6. Decline in death-rate of infants.
7. Increased awareness among people about reproduction related aspects.

89. In sex education necessary in schools ? Why ?

Ans : **SQP 2010**

Yes, the introduction of sex eduction in schools is very necessary to discourage the children from believing in myths and having misconceptions about sex-related aspects. Children have the right to get proper information about reproductive organs, adolescence and related changes, safe and hygienic sexual practices, STD, AIDS etc.

90. What are the suggested reasons for population explosion ?

Ans : **DELHI 2017**

Following are some of the suggested reasons for population explosion:

1. Decline in mortality rate due to increased and improved medical facilities.
2. Decline in infant mortality rate, due to intensive immunization programmes.
3. Decline in maternal mortality rate.
4. Increase in number of people in reproductive age.
5. Increased food production due to intensive agriculture leading to very few deaths due to starvation, famine etc.
6. Increase in longevity.

91. Is the use of contraceptives justified? Give reasons.

Ans : **SQP 2008**

Yes, the use of contraceptive is very much justified. By using contraceptive unwanted pregnancy can be prevented or delayed or a proper gap can be maintained between the first and second child. It will help in bringing birth rate down and in the long run, check uncontrolled growth of population. Use of contraceptives should be promoted and encouraged and all the fertile couples should be brought under its cover.

92. Amniocentesis for ex determination is banned in our country. It this ban necessary? Comment.

Ans : **DELHI 2013**

Yes, the ban imposed on amniocentesis technique for sex-determination is quite proper and justified. Amniocentesis helps in foetal sex-determination and thus there are large number of illegal female foeticide cases disturbing the normal sex ratio in the country, especially the northern states. The people have a great desire and craze for the male child, for social security and religious reason, and go for ex-determination and resultantly female foeticide. Technique amniocentesis has been exploited very much though originally this technique was developed to prevent the birth of genetically abnormal children. Though Govt. of India has legally banned amniocentesis, throughout India but it should strictly be imposed with a severe punishment for defaulters.

93. Removal of gonads cannot be considered as a contraceptive option. Why ?

Ans : **COMP 2006**

Removal of the gonads at all, cannot be considered as a contraceptive option because it has large number of demerits.

1. It is a surgical, irreversible process.
2. It will lead to infertility in both male and female.
3. It interferes with sexual desire.
4. Surgical removal of gonads will also produce side effects, because gonads not only produce sex cells but also secrete hormones. The deficiency of hormones will produce, various disorders. Some important metabilic activities will be affected.

94. Suggest some methods to assist infertile couples to have children.

Ans : **FOREIGN 2007**

Following are some of special assisted reproductive technologies (ART) which can be used to bless and assist infertile couples to have children are:

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1. IVF (In-vitro fertilization) in case of blocked fallopian tubes.
2. ET-Embryo transfer technique (test-tube babies), surrogate mothers can also be used.
3. GIFT-Gamete intrafallopian transfer.
4. ICSI-Intracytoplasmic sperm injection.
5. IUI-Intra-uterine insemination.

95. What are the measures one has to take to prevent from contracting STDs?

Ans : **OD 2009**

STDs are sexually transmitted diseases which are transmitted from an infected person to a normal person through sexual intercourse e.g., AIDS, gonorrhoea; syphilis, genital herpes etc.

Preventive Measures

1. Avoid sex with unknown partners/multiple partners.
2. Always use condom during sexual intercourse.
3. Avoid sharing of injection needles, unsterilized surgical instruments etc.
4. Creating awareness particularly in young peope about the consequences of contracting STDs.
5. In case of doubt do not shy and immediately a qualified doctor should be consulted for early detection and cure of STDs.

96. Correct the following statements :

1. Surgical methods of contraception prevent gamete formation.
2. All sexually transmitted diseases are completely curable.
3. Oral pills are very popular contraceptives among the rural women.
4. In ET techniques, embryos are always transferred into the uterus.

Ans : **SQP 2011**

1. Surgical methods of contraception prevent contact and transport of male and female gametes during sexual intercourse.
2. All sexually transmitted diseases are not completely curable e.g., AIDS. (Few STDs are completely curable if defected early and treated properly).
3. Oral pills are very popular contraceptives among the educated urban women.
4. In ET techniques, Embryos (produced from in-vitro-fertilized eggs) are transferred into uterus for proper implantation, growth and development of embryo.

97. Describe the technique by which genetic disorder in a developing foetus can be detected.

Ans : **FOREIGN 2005**

Amniocentesis is a technique by which genetic disorder in a developing foetus can be detected. This is based on the chromosomal pattern in the cells found in the amniotic fluid surrounding the developing embryo. Amniotic fluid contains cells and molecules shed by the foetus. The chromosomes of foetal cells can also be used to find out the sex of the foetus and abnormalities if any. So, if an abnormality is found, the mother can get the foetus aborted.

98. Write the role of hormones in contraception.

Ans : **FOREIGN 2015**

Progestogens or progestogen-estrogen combinations play an important role in contraception. They are used in the form of tablets or pills. They inhibit ovulation and hence implantation. They are also used by females as injections or implants under the skin. Their mode of action is similar to that of pills but their effective periods are longer.

99. Explain the permanent methods of birth control.

Ans : **COMP 2018**

Sterilisation (surgical methods) is a permanent method of birth control. It is called vasectomy in male and tubectomy in female. In vasectomy, a small part of the vas deferens is removed or tied up through a small incision in the scrotum while in tubectomy, a small part of the fallopian tube is removed or tied up through a small incision in the abdomen or through vagina. These techniques are highly effective but their reversibility is very poor.

NODIA

100. Explain the zygote intra fallopian transfer technique (ZIFT). How is intra uterine transfer technique (IUT) different from it?

Ans : **OD 2024, 2020**

Zygote intra fallopian transfer technique (ZIFT) is a technique of in vitro fertilization wherein the zygote or early embryo having up to 8 blastomeres is transferred into the fallopian tube to complete its further development.

Intra uterine transfer (IUT) technique is different from ZIFT as the embryos with more than 8 blastomers are transferred into the uterus in IUT.

101. How are assisted reproductive technologies helpful to humans? How are ZIFT and GIFT different from intra uterine transfers? Explain.

Ans : **FOREIGN 2005**

The infertile couples could be assisted to have

children through certain special techniques known as assisted reproductive technologies (ART).

ZIFT

The zygote or early embryo with up to 8 blastomers is transferred into the fallopian tube. This is called zygote intra fallopian transfer (ZIFT).

GIFT

It is the transfer of an ovum collected from a donor into the fallopian tube of another female, who cannot produce one but can provide suitable environment for fertilization and further development of the embryo.

Intra uterine transfer (IUT) refers to the introduction of embryo with more than 8 blastomeres into the uterus of a female to complete its further development.

LONG ANSWER QUESTIONS

102. Discuss various methods of contraception for the regulation of population.

Ans : **OD 2018**

The method of deliberately prevent fertilisation to avoid pregnancy are called contraceptive methods. The increase in population can be regulated by using these methods. The various methods used for birth control are as follows.

1. **Natural Methods :** The natural method of contraception work on the principle of avoiding chances of meeting of gametes (fertilisation). This can be achieved by following techniques.
   (a) **Rythm Method :** Sexual intercourse is avoided specially during the ovulation period of menstrual phase.
   (b) **Lactational Amenorrhea :** This method is based on the fact that ovulation (menstruation cycle) do not occur during the period of intense lactation after child birth. This method is considered effectively only upto maximum, six months after delivery and has no side effects.
   (c) **Coitus Interrupts :** Here, penis is withdrawn from vagina before ejaculation
2. **Barrier Methods :** It is based on prevention of fertilisation (meeting of ovum and sperm) by placing a physical or chemical barrier in female reproductive tract.
   (a) **Condom :** It is thin, strong rubber sheath used to cover, the penis in male or vagina and cervix in female during coitus to prevent entry of sperm in the vagina. It is cheap, easy and convenient to use. It also help to prevent STD's. The female condoms are knowns are femidoms. Along with these, cervical caps, Diaphragms and vaults are other barrier used for contraception.
   (b) **IUDs :** These are plastic or metal objects which are inserted in the uterus through vagina by medical professionals IUD promotes phagocytosis of sperms inside uterus. These are available as non-medicated IUDS (e.g. lippese loop), copper, releasing IUDS (CuT, Multiload 375) and hormone releasing IUDS (LNG-20, Progestasert).
   Copper IUDs release copper ions that suppresses motility and fertilizing capacity of sperms.
3. **Chemical Methods :** Chemical spermicide such as lactic acid, zin sulphate etc. in form of cream or jell are applied in female reproductive tract before inter course These chemicals destroy sperms released during ejaculation.
4. **Hormonal Methods :** In this method, hormones (progesterone or progesterone oestrogen combination) in the form of pills are used by females to avoid pregnancy

   They alter or inhibit ovulation and fertilisation or modify the quality of cervical mucus to prevent entry of sperms. Most commonly used oral contraceptives are 'Mala-*D*' and Saheli.

   Beside these, there are emergency contraceptives that can be taken within 72 hours of coitus to avoid pregnancy. It is specially beneficial in case of rape or unprotected sex. e.g. unwanted-72, -pill etc.
5. **Injectables or Implants :** Hormone injections containing progesterone can be also be used in regular interval to avoid pregnancy. Along with it subcutaneous implants of synthetic progesterone are also used. These act similarly to oral cont raceptives. These work upto, period of 5 years
6. **Strerilisation :** It is a permanent method of contraception In it, ducts conducting gametes from gonads to penis in males and uterus in females is blocked by surgical method. It is called as vasectomy in males and tubectomy in females.

103. Write a short essay on reproductive health.

Ans : **OD 2010**

Reproductive health is a state of complete physical, mental and social well-being, and not merely the absence of reproductive disease or infirmity. Reproductive health deals with the reproductive processes, functions and system at all stages of life. It is a reflection of health

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during childhood and crucial during adolescence and adulthood, sets the stage for health beyond the reproductive years for both women and men and affects the health of the next generation Major factors affecting reproductive health are economic circumstances, education, employment living conditions and family environment, social and gender relationships, and the traditional and legal structures within which they live.

The Reproductive and Child Health (RCH) Programme was launched in October 1997. The basic aims of the RCH programme are creating public awareness regarding reproduction-related aspects and providing facilities to build up a healthy society with added emphasis on the health of mother and child.

Major strategies used to achieve these goals are as follows:

1. Introduction of sex education in school that helps in eradicating myths and misconceptions regarding sex-related aspects.
2. Proper information about reproductive organs, safe and hygienic sexual practices and sexually transmitted diseases (STDs).
3. Awareness of problems due to uncontrolled population growth, social evils like sex-abuse and sex-related crimes, etc.
4. Strong infrastructural facilities, professional expertise and material support to provide medical assistance and care to people in reproduction-related problems.
5. Educating people about available birth control options, care of pregnant mothers, post-natal care of mother and child, importance of breast-feeding, equal opportunities for the male and female child.

104. How can the following be prevented in human female?

1. Ovulation
2. Fertilization

Ans : **FOREIGN 2005**

1. **Ovulation :**
   (a) By use of hormonal pills (which prevents the ovulation).
   (b) **Tubectomy :** Female fallopian tubes are cut so the ovum released from ovary is not transported through the fallopian tube.
   (c) **Use of Drugs :** Suppress or delay the maturation of ovum, progesterones.
   (d) **Ovariectomy :** Removal of ovaries.
   (e) **Use of Copper T :** Prevents the process of ovulation.

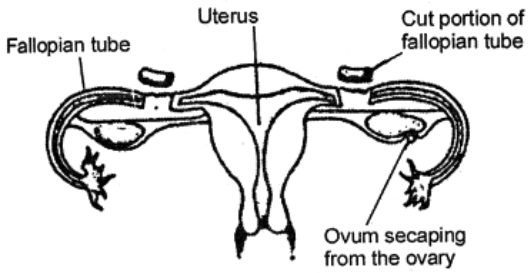
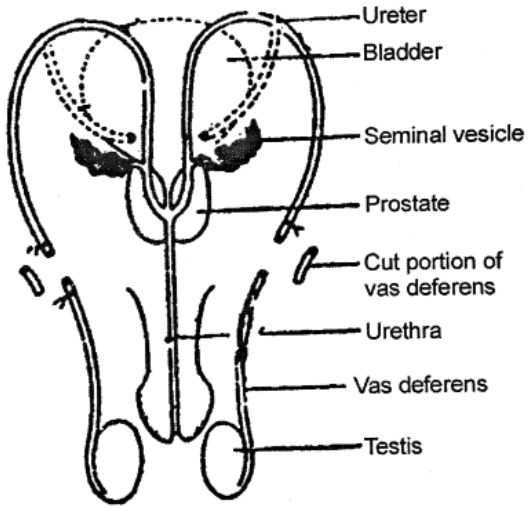


Fig Tubectomy

2. **Fertilization :** Fertilization of an egg can be prevented.
   (a) By Intrauterine contraceptive devices (IUD's) like copper-T and loops.
   (b) By using condoms by males during copulation.
   (c) **Vasectomy :** In males, vasa deferens is being cut and tied.
   (d) **Castration :** Removal of testis.



105. Specify any three scientific methods of preventing pregnancy in humans and explain briefly the manner in which they works.

Ans : **SQP 2012**

Three Scientific Methods of Preventing pregnancy in Humans:

1. **Sterilisation :** It is a permanent method of birth control. It is known as vasectomy in males and tubectomy in females. In vasectomy, vas deferens is cut or short segment is removed. In females oviducts are cut and tied up of the remaining ends tightly by surgical thread. After vasectomy, ejaculation contains no sperms but secretions of various glands only. In tubal legation, fallopian tubes are blocked. Eggs are produced by the ovaries but they

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fail to pass into uterus and the sperms do not reach there for fertilization.

2. **Intra Uterine Devices :** Loop or copper T are used on the cervix of female's vagina to check the entry of spermatozoa into the uterus.
3. **Oral Contraceptive Pills :** They check ovulation because they inhibit the secretion of FSH and LH (which are essential for ovulation in woman). Hence no eggs are released in woman. Conception is then not possible.

106. Name some important sexually transmitted diseases and their causative agents. How are they detected?

Ans : **FOREIGN 2005**

Some of sexually transmitted diseases (over 30 are known in humans) are following :

1. **Trichomoniasis :** It occurs in female's vagina due to infection by Trichomonas vaginalis. It is easily detected by microscopic examination and culture both.
2. **Chlamydiasis :** It is caused by a bacteria, Chalmydia trachomatis, detected by clinical examination, gram staining of discharge, antigen detection and nucleic acid hybridisation etc.
3. **Chanchroids :** It is caused by Haemo-philus ducrei. It is detected by clinical appraisal, and culture also.
4. **Gonorrhoea :** It occurs due to infection of a bacterium Nisseria gonorrhoea, gram + bacterium. It may be detected by gram staining of discharge as well as the culture.
5. **Genital Herpes :** It is caused by Herpes simplex virus. It is detected by clinical examination and antigen test as well as polymerase chain reaction (PCR).
6. **Genital Warts :** These are caused by Human papilloma virus. This may be detected by clinical examination that is followed by antibody detection, culture and DNA hybridisation.
7. **Syphilis :** This is caused by Treponema pallidium. It can be detected by antibody-detection method.

107. Give fertility regulating methods in a tabular form. Mention the method of contraceptives and examples of each.

Ans : **FOREIGN 2016**

The Fertility Regulating Methods are as follows :

1. Contraceptive Methods

These are definite and preventive methods to keep women from unwanted pregnancies these All involve the temporary and permanent measures to prevent pregnancy resulting from coitus/intercourse.

The contraceptives methods are mainly grouped into two types : (1) **Spacing Methods** and (2) **Terminal Methods**.

They are following:

	Metethods of Contraception	**Examples**	**The Advantages (Merits)**	**The Disadvantages (Demerits)**
1.	**Spacing Methods :**			
(A)	**Barrier Methods :**			
	Types			
(i)	Physical	(i) Condoms.	Easily available, safe as well as expensive.	This may slip or tear. It interferes with sex sensation.
		(ii) Diphragm 'dutch cup'	This is vaginal with total absence of risk.	An expert is needed to its proper use.
(ii)	Chemical	Vaginal sponge	This is used soaked in olive oil, foam aerosols, creams, jelly pastes (nonoxynol-9).	May show many side effects.
(B)	**Intra-Uterine Devices (IUCD)**	Mostly made of polyethylene polymers, e.g., Lippes Loop. Many copper bearing devices are now commercially available example is copper T, Cu-7.	(i) Simplicity, (ii) once inserted IUD stays at that site for long as needed.	

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(C)	**Hormonal**	Most effective spacing	Easy to use.	May show side ill effects.
	Contraceptives	Methods of contraception; oral contraceptives of combined type: app. 100% effective to prevent pregnancy. More than 65 million young people of world are estimated to be using female 'pill'. About 10 million are estimated to be in our country; the example is: Synthetic estrogens Synthetic progestogens like Mala-N and Mala-D.		
		The Male oral pill consists of Gossypium oil (a derivative of cotton seed Gossypol).		At least their use for six months may bring permanent sterility in a person.
2.	**Terminal Methods**	The male as well as female sterilisation.	It is the most safe method.	There is no side effect of it.

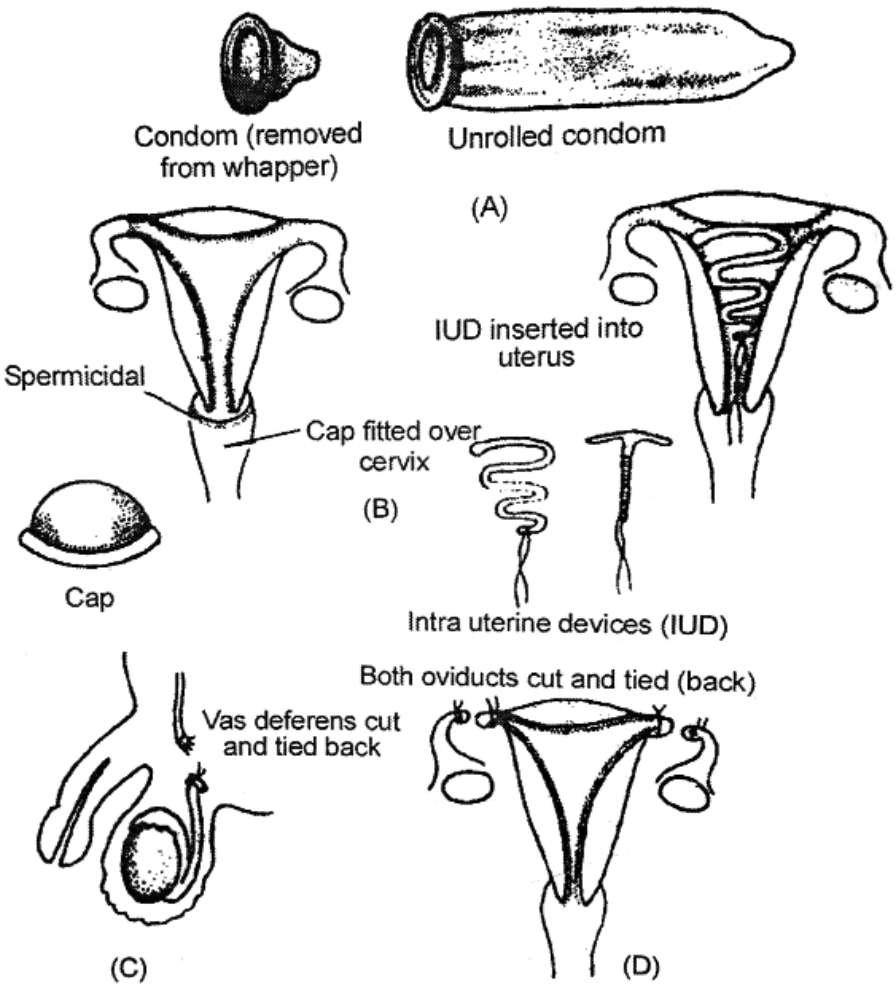

Fig Different types of birth control measures

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108. Describe various methods of birth control in human beings.

Ans : **FOREIGN 2005**

A wide range of contraceptive methods (methods of birth control) are being used by human beings. These methods are broadly grouped into the following categories namely natural or traditional, barrier, IUDs, oral contraceptives, injectable, implants and surgical methods.

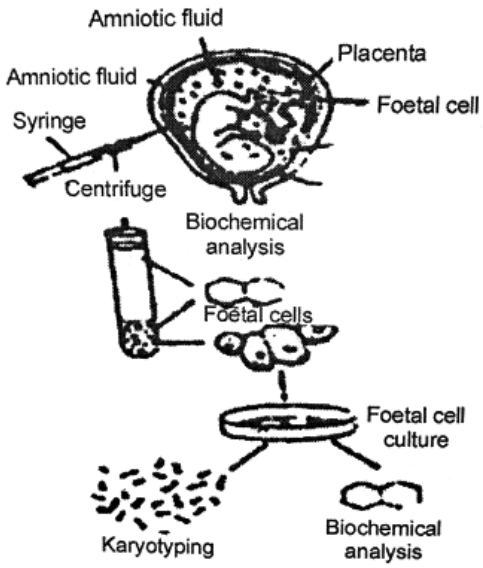
1. **Natural Methods :** These methods work on the principle of avoiding fusion of a sperm with ovum. These are of the following types:
   (a) **Periodic Abstinence :** In this method fertile couples avoid coitus from the day 10 to 17 of menstrual cycle when ovulation could be expected. Abstaining from coitus during this period, conception could be prevented.
   (b) **Coitus Interruptus :** In this method the male partner withdraws his penis from the vagina just before ejaculation so as to avoid insemination and conceivement of the female. This methods is not fully safe.
   (c) **Lactational Amenorrhea :** This method is based as the presumption or fact that menstrual cycle and thus ovulation do not occur during the period of intense lactation following birth of a child. Therefore, as far as the mother breast feed her baby chances of conception are almost nil. However this method is not fully safe.
2. **Barriers :** Use of barriers prevent the physical union of male gamete with the female gamete. These methods are available both for males and females and are 100% safe. Some of these are:
   (a) **Condoms :** These are made up of thin rubber or latex sheath. They are used to cover the penis in the males or the vagina and cervix in the females just before the sex, so that the ejaculated sperms would not enter into the female reproductive tract.
   (b) **Diaphragms, Cervical Caps and Vaults :** These are also made up of rubber or latex and are inserted into the female vagina and cervix before the sex. They block the entry of sperms through the cervic and prevent conception.
3. **Intra Uterine Devices (IUDs) :** These devices are inserted into the uterus of the female through her vagina. Commonly available intra uterine devices are : non-medicated IUDs (e.g. Lippes loop), Copper releasing IUDs (CuT, Cu7, multiload 375) and hormone releasing IUDs (Progestasert, LNG-20) IUDs prevent conception by:
   (a) Increasing phagocytosis of sperms in the uterus.
   (b) Cu^{++} released from copper IUDs supress sperm motility and fertilising capacity of the sperms.
   (c) Hormone releasing IUDs make uterus unsuitable for implantation and the cervix hostile to the sperms.
4. **Contraceptive Pills :** Oral administration of contraceptive pills containing small doses of progestogens or progestogen-estrogen combinations prevents ovulation and implantation. They also alter the quality of cervical mucus. These changes prevent or retard entry of sperms.
5. **Surgical Methods :** Sterilisation procedure in the male iscalled vasectomy and in a female is called tubectomy. Vasectomy and tubectomy both blocks gamete transport and there by prevent pregnancies.

109. What is amniocentesis? Comment on the misuse of the technique of amniocentesis.

Ans : **FOREIGN 2005**

Amniocentesis is the prenatal diagnostic technique by which foetal cells can be made available to examine outside mother's body.

1. **Use of Amniocentesis :** For detection of congenital diseases and sex determination.
2. **Misuse of Amniocentesis :** This beneficial technique has been presently misused by many unscruplous doctors and parents. Since it is easy to find the sex of the foetus by this technique, female foetus which would have been absolutely normal have been ruthlessly destroyed in order to have a male child only.



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110. Write brief notes on the following:

1. What is artificial insemination? What is its significance?.
2. What are implants? Where they are placed in the body? What is their importance?

Ans : **COMP 2008**

1. **Artificial Insemination :** In this technique the semen collected either from the husband or from donor male is artificially injected into the vagina or uterus of the female to get her conceived.

   Artificial insemination is useful in cases where the male is either having very low sperm count or his semen is without sperms or he is suffering from penial dysfunction. In such cases he is unable to get her wife conceived. By artificial insemination her wife is able to produce young one.
2. **Implants :** Implants are the contraceptive materials these are placed in the body of a female. They are generally implanted under the skin. Norplant (six rods implanted under the skin) and implanous (one rod implant) are 99% effective to prevent pregnancy. They inhibits ovulation.

111. State the role of education upon women in our society.

Ans : **DELHI 2011**

Education plays role in development of child. The female child with more education tend to be more prosperous and healthier. Educated women have a few but healthier children. Some evils like early pregnancy. Child bearing and poverty are mostly related to less educated women. The young women of age between15-19 years face serious health risks. The reason is their incomplete growth. The height and pelvic size do not grow fully. This cause great risk of obstructed labour. If birth canal is blocked, it may cause injury or death of the foetus delivered child or even the mother.

The infants of young mothers are most immature. They have low birth rates also. So education has a key role in womens and children of our society.

112. What is infertility? Give a brief account of assisted reproductive technologies (ARTs) to overcome the problem of infertility.

Ans : **DELHI 2005**

Infertility : Inability to conceive or produce children even after two years of unprotected sexual cohabitation is called infertility.

Assisted Reproductive Technologies :

1. **Test Tube Baby Programme :** It involves in-vitro fertilization and transfer of zygote (at 8 celled stage in the fallopian tubes or more than 8 Blastomeres in the uterus) in the female reproductive tract. For this ova from the wife/donor (female) and sperms from the husband or donor (male) are collected and are induced to form zygote under simulated conditions in the laboratory. The zygote or early embryos (upto 8-blastomeres) are then transferred into the fallopian tubes (ZIFT-Zygote intra fallopian transfer) and embryo with more than 8 blastomeres into the uterus (IUT-intra uterine uterine transfer) to complete further development. baby born by this methods is called a test-tube baby.
2. **In-Vivo Fertilized Zygotes :** (fusion of sperm and eggs within the female) and developed embryo taken from one female and transfer to another female who cannot conceive for further development is also employed or to assist for getting a baby.
3. **Gamete Intra Fallopian Transfer :** Transfer of an ovum collected from a donor into the fallopian tubes of another female who cannot produce one, but can provide suitable environment for fertilization is another ART for producing a baby.
4. **Intra Cytoplasmic Sperm Injection (ICSI) :** In this technique an embryo is developed in the laboratory in which a sperm is directly injected into the ovum. This embryo is then transferred in the fallopian tubes or uterus for further development of the baby.
5. **Artificial Insemination :** Infertility cases either due to inability of the male partner to inseminate the female or due to very low sperm count in the ejaculates, could be corrected by artificial insemination technique.

   In this technique the semen collected either from the husband or from a healthy donor is artificially injected either into the vagina or into the uterus of the female for conceiving the female.

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CASE BASED QUESTIONS

113. Population represents the total number of individuals of a species living in an area. In last century, all around the world development in various fields significantly improved quality of life of people. Increased health facilities along with better living conditions had an explosive impact on the growth of population.

(i) What is population explosion

(ii) What are the direct consequences of Over population

(iii) How one can control over population ? Give on example of each contraception.

Ans :

(i) The rapid increase in the population Over a relatively short peviod is called population explosion.

(ii) (i) Short age of food supply
(ii) Unemployment
(iii) Education
(iv) Poverty

(iii) By adopting contraceptive measures as :
(i) Barrier Methods eq candom
(ii) Natural method eq Lactational Amenorrhoea
(iii) IUD'S eg; CU—T
(iv) Oral contraceptives eg; Saheli

114. The oral contraceptives are the preprations of hormones either progestogens or progestsgen-Oestrogen combinations in the form of pills. They are mainly used by females.

(i) From what time period the oral pills are taken by females for contraception

(ii) I low does these pills work 7

(iii) Give any two common examples of Oral pills.

Ans :

(i) The oral pills are generally taken for the period of 21 days starting within the first five days of menstrual cycle.

(ii) They alter or inhibit Ovulation and fertilisation and also modify the quality of cervical mucus to precent or retard the entry of sperms.

(iii) The common examples are sahcls and Mala-D.

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CHAPTER 4

PRINCIPLES OF INHERITANCE HEREDITY AND VARIATION

SUMMARY

1. BASIC CONCEPTS

The basic concepts of principle of inheritance heredity and variation are as follows :

1. **Inheritance** : Like begets like, means the living things produce offspring which resemble themselves. It shows the **continuity of life**.
2. **Heredity** : It refers to the study of transmission of characteristics from one generation to another generation of living things.
3. **Variations** : These are the differences between parents and their offsprings as well as among themselves.

   The **continuity of life** and **variation** from the integral parts of heredity. Mating of closely related organisms is called as **inbreeding**.
4. **Clones** are the group of cells or individuals which are genetically identical.
5. **Genes** : They control the heredity and determine the phenotype of an organism.

2. PRE-MENDELIAN IDEAS ABOUT INHERITANCE

Darwin gave the idea in light of **embryology** and cell theory. He said all cells of our body contain gemmules, the microscopic entities that are passed on to the zygote through the gametes. So Darwing proposed the **theory of Pangenesis**.

The characters of parents may get mixed or **blended** in progeny. This was weakened by atavism or **throwback** or **reversion**.

August Weismann gave the theory of **germplasm and somatoplasm**.

3. MENDELIAN INHERITANCE

Gregor Mendel and his Theory of Inheritance : The process of transmission of characters began with **Gregor Mendel** when he studied the inheritance of **seven characters** in garden pea (pisum sativum) in 1956.
Mendel was crowned with success in his experiments with pea plant whereas his predecessors failed.

4. MENDEL'S EXPERIMENT

Mendel experimented on garden pea. He hybridised plants with a pair of contrastinh characters to produce F_1. He allowed F_1 for self fertilization. F_2 was obtained.

Monohybrid cross is a cross where two forms of a single character are hybridized.

He then raised F_3 and F_4 generations. He extended his work to two set of contrasting traits (dihybrid cross) and then to more (polyhybrid cross).

5. EXPERIMENTAL METHOD

Progent of F_1 generation resemble only one parent (usually dominant). The expressed character in F_1 progeny is called **dominant** and the hidden is called **recessive**. **Monohybrid ratio** obtained is 3:1 and dihybrid ratio is 9:3:3:1. Study of genes or inheritance of character from parent to offspring is called **genetics**. **Heterozygous** are the members of pair of allelle, different and homozyhous are alike. The genetic constitution of an organism is called **genotype**. The form, appearance, behaviour and reproduction in an individual is collectively called **phenotype**.

6. DEVIATIONS FROM MENDELISM

The offsprings of Parental (P_1) generations were **hybrids** and resembled to one parent only. Both forms of P_1 were expressed in F_2 generation. These were called dominant and **recessive**. Mendel also made **reciprocal crosses**. So he proposed **4 principles-**

1. Law of dominane
2. Law of paired units
3. Law of segregation
4. Law of independent assortment.

7. METHODS OF ANALYSIS

The punnett Square : It was deviced by **R.C. Punnett** (1906). Various combination of gametes shows the genotypes and phenotypes. The possible gamete is kept in an individual **row/ column** having **vertical column** showing female

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having horizontal row of male parents. It is shown by **boxes** or **squares**.

8. TEST CROSS ; BACK CROSS

Test cross is the cross involving the F_1 offspring and recessive parents **Monohybrid test cross ratio** is 1:1 but **dihybrid test cross ratio** comes to 1:1:1:1. **Back cross** is the cross in between F_1 progeny with either of the parents. The homozyhous **breed true** but heterozygous genotype show the law of segregation.

9. TRIHYBRID CROSS

Dihybrid cross involves the hybridization between contrasting pairs for two traits in the true breeding lines. Mendel made some **3-factor cross** called **trihybrid crosses**.

10. POST MENDELIAN ERA

The hereditary determinant of factors present on the chromosomes are **genes**. After the rediscovery of the Mendel's work in 1900 the study of genetics was expanded to many other plants and animals and several other traits. It led to many **alternative modes of inheritance**. These arose due to two types of interactions one at the level of alleles and the other between **non-alleles**. **Mendelian F_2 ratio** 9:3:3:1 was **modified** or **deviated**.

Mutant alleles were derived from **wild type** (+) and they were designated by a superscript etc.

11. INCOMPLETE (PARTIAL) DOMINANCE

Incomplete dominance is the intermediate inheritance of dominant and recessive genes. Incomplete (partial) dominance and codominance led to different phenotypic expressions in the heterozygotes, due to the absence of complete dominance e.g., flower colour in Mirabilis jalapa and body colour in cattle respectively.

12. CODOMINANCE

The alleles which are dominant over each other and are both expressed in the phenotype are called **codominant**. In a hybrid both alleles express themselves. It was also seen in **MN blood groups**-RBC's possess 2 nativeantigens M and N. So the individuals may be NN, MM or MN etc.

13. MULTIPLE ALLELES AND MULTIPLE ALLELISM

Certain genes for which more than two alletic forms exist are called **multiple alleles** e.g., ABO blood groups in humans. Eye colour in Drosophila melanogaster and self sterility in some plants are other examples.

14. TWO GENE INTERACTIONS

Sometimes, the phenotype is the outcome of more than one non-allelic genes. Here one gene is not sufficient to produce a particular phenotype. The genes express interactions at the phenotypic level.

15. EPISTASIS

The word epistasis means standing on. Epistasis is the phenomenon of dominance (expression) of one gene over the other. Non-allelic gene(The suppressing one) is called hypostatic gene. e.g., the flower colour in sweet peas (Lathyrus odoratus) is due to the **supplementary genes** where one gene completes the action of the other gene. F_2 9:3:3:1 ratio is modified to 9:7 in case of supplementary genes.

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16. POLYGENIC INHERITANCE

Galton (1883) prodosed that several examples of the continuous variations are heritable. He called it **cumulative** effect of several genes that govern the same character e.g. Intelligence in man and milk yield in animals are controlled by many genes (effect is cumulative/Quantitative) each gene has **some effect**. The omre number of dominant genes cause greater expression of that character. It is called **multiple factor inheritance too**. **Polygenic Traits** e.g., human skin colour and height; seed size, colour, plant height and yield of crops. The **polygenic inheritance** is called **Quantitative Inheritance** where a particular trait is controlled by 2 or more genes and the graded phenotypes are produced due to the additive effects of various genes of a trait/character. Such traits produce gradations due to the additive effect of the genes.

17. PLEIOTROPY

Some genes (more than one) controlling the inheritance of a character are called **additive genes** and one gene controlling more than one traits is called **pleiotropic gene**. e.g., is garden pea the same gene controls both flower colour and the seed coat colour. **Sickle cell anaemia** and resistance to malaris fever is controlled by the same gene.

18. CHROMOSOME THEORY OF INHERITANCE

It was suggested by Sutton and Baveri in 1902 which states that Medelian genes are located on chromosomes and it is the chromosomes which segregate and assert independently.

19. INDEPENDENT ASSORTMENT OF GENES VERSUS LINKAGE

Some genes do not follow the principle on independent arrortment and they are called **linked genes.** Linkage was discoverd by **Bateson and Punnett** (1906). They formulated **coupling** and **Repulsion Theory**.

20. COMPLETE AND INCOMPLETE LINKAGE

In complete linkage there is formation of parental gametes or non-cross over gametes and no recombination are produced.

1. Crossing over is the physical exchange of parts of non-sister chromatids of homologus chromosomes during meiosis. It is called **incomplete linkage**.
2. The place or site where two non-sister chromatids of paired homologus chromosomes physically cross over is called **chismata** (singular-**chisama**)
3. The map showing relative distance of linked genes on a chromosome during transference of characters is called lingage map. They are also called genetic maps. The mapping is imported in **genetic engineering** and **entire genome**.
4. **Linkage groups** are the groups of linked genes inherited together in the gametes or progeny.

21. CROSSING OVER

Crossing Over is the exchange of chromosomes segments between non-sister chromaticls during the production of gawetes.

22. RECOMBINATION

The recombination may be defined as a meiotic process which generates the haploid (N) product whose genotype remains different from two haploid genotypes that make diploid (2N) Recombinant is the product of recombination phenomenon.

23. CHROMOSOME MAPPING

Chromosome map is called a **genetic map or cross over map**. It is done by **test cross** and knowing the **crossing over frequency**.

$$\text{Recombination Frequency} = \frac{\text{Total Number of Recombinants} \times 100}{\text{Total Number of Progeny}}$$

24. SEX LINKED INHERITANCE

1. **T.H. Morgan** worked with the fruit fly for **sex linked inheritance**. In is called **sex linkage**.
2. Drosophila has four pairs of chromosomes. Three pairs (II,III and IV) are autosomes and the fouth pair 1. is **allosome** or **sex chromosome** (XX in female and XY in male). The Y chromosome in Drosophila is characteristically J shaped. It is genetically **inert**.
3. **T.H. morgan** worked with the fruit fly Drosophila melanogaster for **cris cross inheritance**. It occurs through the sex chromosomes.

25. SEX-DETERMINATION

Basis fo Sex Determination :

1. The sexually differentiated species (dioecious). Sex chromosmes X and Y have been identified. All other chromoses are called autosomes. The genes located on **sex chromosomes** follow a definite pattern on inheritance.
2. In **birds** and some **reptiles**, females are **heterogametic** and males are **homogametic**. Here **WZ system** is used in place of **XY system**, and males are **WW** and females are **WZ**.
3. In human beings the individuals with altered sex chromosome composition have shown that Y chromosome is responsible for **male differentiation**. But in Drosophila the same is controlled by the ration between the number of X-chromosomes and the set of autosomes.

NODIA

26. GENETIC VARIATIONS

They may arise due to the following : Gene mutation, recombination, gene environment interactions and the chromosomal abberrations or the structural changes in chromosomes.

27. GENE MUTATION/POINT MUTATION

Sudden or abrupt change in the genes is called mutation or gene mutation or point mutation.

28. CHROMOSOMAL ABERRATIONS

They are the changes in the structure of chromosomes. This change may be in chromosome number. Recombination is one important source of genetic variability.

29. THALASSEMIA

It is a **genetic disease**. It originated in **Mediterranean** region by **mutation or deletion**. In this disease; few **globins** are **synthesized**. It differs from the **sickle cell** anaemia in the respect that

in sickle cell anaemia- There occurs synthesis of incorrectly functioning globin at all.

Symptoms of Thalassemia : The globin free chains (insoluble) a**ccumulate inside** RBC's and make **precipitates** (ppt) that destroy cell by causing lysis and produce **Anaemia**.

Cause of Thalassemia : It is caused by **defeats** in synthesis of **globin polypeptide.**

30. NUCLEOID

It is **prokaryotic chromosomes** consisting of a farge circular chromosome. Eukaryotic chromosomes are complex in structure. They are made of spherical units called **nucleosomes**.

31. HUMAN GENETICS

It is studied by **pedigree analysis**. The **father of human genetics- Sir Archibald Garrod**. A system for following the movement and distribution of certain genetic traits is called **pedigree analysis**.

32. GENETIC DISORDERS AND GENETIC COUNSELLING

It is an important rule to check the spread of diseases. Sickle cell anaemia, phenylketoneuria, cystic fibrosis, **colour blindness, haemophilia**, Huchinsons disease, Down syndrome, Alzheimer's Disease are some known **human genetic disorders**.

Father passes the X-linked allele trait to their daughters but not to their sons. Mother passes the allele of the trait to both sons and daughters.

OBJECTIVE QUESTIONS

1. Genes present on same locus having different expressions are called:
(a) Multiple allele
(b) Polygene
(c) Oncogene
(d) Codominant gene

Ans : **OD 2024, 2018**
Three or more alternative forms of gene that occupy the same locus but express differently are called as multiple alleles. eg. human blood group.
Thus (a) is correct option.

2. Sickle cell anaemia shows:
(a) Epistrasis
(b) Co-dominance
(c) Pleiotropy
(d) Incomplete dominance

Ans : **OD 2018**
Sickle cell anaemia is a genetic disorder caused by presence of a defective allele on chromosome. In homozygous condition, the disorder kills the individual while in heterozygous condition, it demonstrate co-dominance as both normal and mutant forms co-exist in blood stream here, it leads to haelmolytic anaemia under conditions of oxygen 60-70% deficiency.
Thus (b) is correct option.

3. The trisomy of 21st chromosome causes:
(a) Klinefelter's syndrome
(b) Turner's syndrome
(c) Sickle cell anaemia
(d) Down's syndrome

Ans : **OD 2018**
Trisomy of 21st chromosome causes down's syndrome. It is also known as mongolism. It occurs due to non disjunction of homologous chromosome during meotic division.
Thus (d) is correct option.

4. A normal vision female whose father is colour-blind marries a normal vision male. What would be the probability of her sons and daughters to be colour blind ?
(a) 25% sons colour blind and all daughters with phenotypically normal vision.
(b) 50% sons colour blind and 50% daughter normal.
(c) 50% sons colour blind and 50% daughter colour blind.

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(d) All sons normal and 50% colour blind daughter.

Ans : **OD 2018**

In the given case, the female acts as carrier of disease so, there is a probability that her half of son's (50%) will be colour blind and half of daughters (50%) have normal vision but acts as carrier of the disease.
Thus (b) is correct option.

5. A child with blood group 'O' has 'B' blood group type father then the father has genotype of:
(a) I^OI^O (b) I^OI^B
(c) I^BI^B (d) I^AI^A

Ans : **OD 2018**

An individual who express blood group O must be $I^\circ I^\circ$ in genotype. The parents of this person could both be O$(I^\circ I^\circ \times I^\circ \times I^\circ)$, or could both be A $(I^AI^\circ \times I^AI^\circ)$ or B$(I^BI^\circ \times I^BI^0)$ to produce one fourth $(I^\circ I^\circ)$ progeny They could also be one A(I^AI°) and other B(I^BI°).
Thus (b) is correct option.

6. Which blood group is called universal donor?
(a) B (b) A
(c) AB (d) O

Ans : **OD 2018**

People with blood group 'O' are termed as universal donor. This is because, such individuals do not have either A or B antigens on the surface of their RBCs. Thus, they can be matched with any ABO blood group.
Thus (d) is correct option.

7. Which one is phenotypic ratio of Monohybrid cross?
(a) 1:2:1 (b) 3:1
(c) 9:3:3:1 (d) None

Ans : **OD 2017**

In monohyprid cross, the phenotypic ratio of 3:1 is obtained. In F_2 generation, 1:2:1 is their genotype ratio, while 9:3:3:1 is a phenotypic ratio of dihybrid cross in F_2 generation.
Thus (b) is correct option.

8. Which one is phenotypic ratio of dihybrid cross?
(a) 1:2:1 (b) 3:1
(c) 9:3:3:1 (d) None of these

Ans : **OD 2016**

Phenotypic ratio of dihydrid cross in F_2 generation is 9:3:3:1. The 1:2:1 is genotypic and 3:1 is phenotypic ratio of F_2 generation in monohybrid cross.
Thus (c) is correct option.

9. A person suffering from colour blindness cannot recognise
(a) red and yellow colors
(b) red and green colors
(c) blue and green colors
(d) none of these

Ans : **OD 2015**

Colour blindness is a x-linked hereditary disease in which a person fails to recognise red and green colour. This disease affects males more frequently than females.
Thus (b) is correct option.

NODIA

10. In human blood group AB
(a) antibodies are present
(b) antibodies are absent
(c) antibody *a* is present
(d) antibody *b* is present

Ans : **OD 2015**

A person of blood group AB has both *a* and *b* antigens on the surface of their RBC and no *a* or *b* antibodies at all in their blood plasma.
Thus (b) is correct option.

11. Mendel proposed
(a) law of linkage (b) 10% energy law
(c) law of inheritance (d) none of these

Ans : **OD 2015, 2011**

Mendel proposed laws of inheritance on the basis of conclusions drawn from his genetic hybridisation experiments.
Thus (c) is correct option.

12. Who is considered as father of genetics?
(a) Hugo de Vries (b) Morgan
(c) Mendel (d) Darwin

Ans : **OD 2012**

Mendel is regarded as the father of genetics. He was first person to give scientific explanation for the mechanism of transmission of characters from parents to the offspring, generation after generation.
Thus (c) is correct option.

13. In which stage does crossing over take place ?
(a) Leptotene (b) Cytokinesis
(c) Pachytene (d) Diakinesis

Ans : **OD 2012**

Crossing over takes place during Leptotene stage of Meiosis-I.
Thus (a) is correct option.

14. Mendel selected:
(a) Gram (b) Pinus
(c) Tomato (d) Garden pea

Ans : OD 2011
Mendel selected garden peapeant (Piscun sativum) for their heredity experiments.
Thus (d) is correct option.

15. Crossing over takes place in:
(a) Zygotene (b) Leptotene
(c) Pachytene (d) Metaphase

Ans : OD 2011
Exchange of genetic material between non sister chromatids of homologous chromosomes during meosis is called as crossing over. It occurs in the pachytene stage of prophase I of meosis I.
Thus (c) is correct option.

16. Which disease is due to haemoglobin's defect?
(a) Down's syndrome
(b) Pheryl Ketonuria
(c) Klinefelter syndrome
(d) Sickle cell anaemia

Ans : OD 2011
Sickle cell anaemia is caused due to abnormality in the oxygen carrying protein haemoglobin found in red blood cells. The abnormal haemoglobin causes distorted (Sickled) red blood cells. It occurs due to mutations in HBB gene.
Thus (d) is correct option.

17. How many characters were studied by Mendel?
(a) Five (b) Four
(c) Seven (d) Three

Ans : OD 2011
Mendel selected seven pairs of contrasting characters for his historic hybridisation experiments on garden pea plant.
Thus (c) is correct option.

18. Law of segregation is also known as:
(a) Law of dominance
(b) Law of independent assortment
(c) Law of thermodynamics
(d) none of these

Ans : OD 2011
Law of segregation is also known as law of independent assortment. It states that in a hybrid heterozygote, the two members of the allelic pair remain together without blending. When gametes are formed from the hybrid, the two genes segregate out of which only one enters in each gamete.
Thus (b) is correct option.

19. An exception of Mendel's law is:
(a) Dominance
(b) Purity of gamete
(c) Linkage
(d) Independent assortment

Ans : OD 2010
Linkage is an exception of Mendel's laws. It violates the law of Independent assortment. Linkage is a property of genes of being inherited together.
Thus (c) is correct option.

20. A gene pair hides the effect of another gene pair. The phenomenon is:
(a) Epistasis (b) Dominance
(c) Mutation (d) None of these

Ans : OD 2009
Epistasis is a type of gene interaction where a gene pair (dominant gene) hides the effect of another gene pair (recessive gene).
Thus (a) is correct option.

21. The number of linkage groups in a cell having $2n = 14$ is:
(a) 5 (b) 10
(c) 7 (d) 14

Ans : OD 2009
The cell having 2n=14 then, number of linkage group will be 7.
Thus (c) is correct option.

22. Mutations used in agriculture are commonly
(a) induced
(b) lethal
(c) lethal
(d) recessive and lethal

Ans : DELHI 2005
Induced mutations are produced in response to external factors of chemicals called mutagens. In agriculture mutagens are used to induce desired mutations in crop plants.
Thus (a) is correct option.

23. Diploid chromosome number in humans is
(a) 46 (b) 44
(c) 48 (d) 42

Ans : COMP 2008
Chromosomes occur in homologous pairs. Somatic cells have diploid number of chromosomes. Humans have 23 pairs i.e. 46 chromosomes. 22 pairs of autosomes and 1 pair of sex chromosomes i.e. XX in females and XY in males.
Thus (a) is correct option.

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24. Triticale has been evolved by intergeneric hybridization between
(a) wheat and rye
(b) wheat and rice
(c) rice and maize
(d) wheat and Aegilops

Ans : **OD 2010**

Triticale is a man made cereale produced by crossing two generate wheat (Triticum) and rye (Secale). Hexaploid Triticale was obtained by crossing Triticum durum and Secale cereale.
Thus (a) is correct option.

25. tt mates with Tt. What will be characteristic of offspring?
(a) 75% recessive (b) 50% recessive
(c) 25% recessive (d) All dominant

Ans : **DELHI 2013**

On mating tt with Tt, 50% individual offsprings are recessive and 50% are heterozygous dominant.
Thus (b) is correct option.

26. The allele which is unable to express its effect in the presence of another is called
(a) codominant (b) supplementary
(c) complementary (d) recessive

Ans : **SQP 2010**

The allele which cannot impress its effect in the hybrid or in the presence of dominant allele is termed as recessive. It is denoted by small letter.
Thus (d) is correct option.

27. ABO blood group system is due to
(a) multifactor inheritance
(b) incomplete dominance
(c) multiple allelism
(d) epistasis

Ans : **SQP 2016**

A gene may have more than two alternative forms occupying the same locus on a chromosome such alleles are known as multiple alleles and the phenomenon is turned as multiple allelism. ABO blood group has 3 alleles. I^O, I^A or A, I^B or B.
Thus (c) is correct option.

28. An octamer of 4 histones complexed with DNA forms
(a) endosome (b) nucleosome
(c) mesosome (d) centromere

Ans : **FOREIGN 2012**

Nucleosomes are oblate spherical structure having an octamer of four histone proteins (constituting 2 molecules of each type).
Thus (b) is correct option.

29. In Down's syndrome of a male child, the sex complement is
(a) XO (b) XY
(c) XX (d) XXY

Ans : **COMP 2017**

Down's syndrome is due to trisom 21st chromosome and is an autosomal abnormality.
Thus (b) is correct option.

30. Red (RR) Antirrhinum is crossed with white (WW) one. Offspring RW are pink. This is as example of
(a) dominant-recessive
(b) incomplete dominance
(c) hybrid
(d) supplementary genes

Ans : **SQP 2014**

Incomplete dominance is the phenomenon of none of the alleles being dominant with the effect that the hybrid produced by crossing two pure individuals is a mixture between the parents.
Thus (b) is correct option.

31. Mendel's last law is
(a) segregation
(b) dominance
(c) independent assortment
(d) polygenic inheritance

Ans : **OD 2009**

According to the law of Independent Assortment, alleles of different characters located in different pairs of homologous chromosomes are independent of one another in their separation or segregation during gamete formation.
Thus (c) is correct option.

32. First geneticist/father of genetics was
(a) de Vries (b) Mendel
(c) Darwin (d) Morgan

Ans : **DELHI 2007**

Gregor Johann Mendel formulated the laws of heredity and is regarded as the father of genetics.
Thus (b) is correct option.

33. The constrasting pairs of factors in Mendelian crosses are called
(a) multiple alleles (b) allelomorphs
(c) allococi (d) paramorphs

Ans : **FOREIGN 2018**

Allelomorphs control different expressions or traits of the same character.
Thus (b) is correct option.

NODIA

34. Multiple alleles control inheritance of
(a) phenylketonuria (b) colour blindness
(c) sickle cell anaemia (d) blood groups

Ans : COMP 2020

Blood groups in human are controlled by multiple alleles.
Thus (d) is correct option.

35. A man of A-blood group marries a women of AB blood group. Which type of progeny would indicate that man is heterozygous A?
(a) AB (b) A
(c) O (d) B

Ans : OD 2023

$I^AI^O \times I^AI^B$ gives us the following genotypes I^AI^A, I^OI^B, I^AI^B.
Thus (d) is correct option.

36. An organism with two identical alleles is
(a) dominant (b) hybrid
(c) heterozygous (d) homozygous

Ans : FOREIGN 2021

Homozygous individuals have identical mendelian factors or genes for a character (TT or tt). They are always pure for a particular trait (character).
Thus (d) is correct option.

37. Segregation of Mendelian factors (no linkage, no crossing over) occurs during
(a) anaphase I (b) anaphase II
(c) diplotene (d) metaphase I

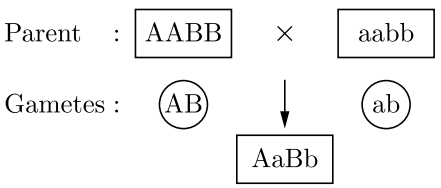
Ans : DELHI 2005

At anaphase I, actual segregation occurs, but two similar alleles occur in the dyad chromosome which separate at anaphase II.
Thus (a) is correct option.

38. In a cross between AABB × aabb, the ration of F_2 genotypes between AABB, AaBB, Aabb and aabb would be
(a) 9:3:3:1 (b) 2:1:1:2
(c) 1:2:2:1 (d) 7:5:3:1

Ans : SQP 2008

Genotype is the genetic make up of an individual irrespective of the mendelian characters of genes impressing.



	AB	**Ab**	**aB**	**ab**
AB	AABB	AABb	AaBB	AaBb
Ab	AABb	AAbb	AbBb	Aabb
aB	AaBB	AaBb	aaBB	aaBb
ab	AaBb	Aabb	aaBb	aabb

Thus (c) is correct option.

39. A gene pair hides the effect of another. The phenomenon is
(a) epistasis
(b) dominance
(c) mutation
(d) none of the above

Ans : DELHI 2012

Epistasis is the phenomenon of masking or supressing the phenotypic impression of a gene pair by a non allelic gene pair which impresses its own effect.
Thus (a) is correct option.

40. An allele is dominant if it is expressed in
(a) both homozygous and heterozygous states
(b) second generation
(c) haterozygous combination
(d) homozygous combination

Ans : OD 2013

Dominant alleles express itself in the homozygous as well as heterozygous condition. It is denoted by capital letter.
Thus (a) is correct option.

41. A dihybrid condition is
(a) tt Rr (b) Tt rr
(c) tt rr (d) Tt Rr

Ans : DELHI 2009

Dihybrid condition involves simultaneous inheritance of two pairs of medelian factors or genes.
Thus (d) is correct option.

42. A child of O-group has B-group father. The genotype of father will be
(a) I^OI^O (b) I^BI^B
(c) I^AI^B (d) I^BI^O

Ans : COMP 2018

The genotype of the child would be I^OI^O (recessive). Hence the genotype of the father can only be I^BI^O.
Thus (d) is correct option.

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43. In human beings 45 chromosomes/single X/XO abnormality causes
(a) Down's syndrome
(b) Kinefelter's syndrome
(c) Turner's syndrome
(d) Edward's syndrome

Ans : **OD 2019**

Turner syndrome encompass several chromosomal abnormalities of which monosomy X is the most common. It occurs in 1 out of every 2500 female births. Instead of the normal XX sex chromosomes for a female, only one X chromosome is present and fully functions. This is called 45, X or 45, XO although other genetic variants occur. In Turner syndrome, female sexual characteristics are present but generally underdeveloped.
Thus (c) is correct option.

44. Nucleosome core is made of
(a) H1, H2A, H2B and H3
(b) H1, H2A, H2B, H4
(c) H1, H2A, H2B, H3 and H4
(d) H2A, H2B, H3 and H4

Ans : **OD 2019**

The four histone proteins constituting the core of nucleosome are H2A, H2B, H3 and H4.
Thus (d) is correct option.

45. Down's syndrome is due to
(a) crossing over
(b) linkage
(c) sex-linked inheritance
(d) nondisjunction of chromosomes

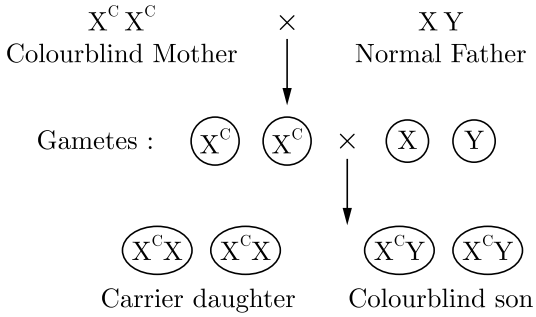
Ans : **DELHI 2023**

Down's syndrome is due to non-disjunction of chromosomes. Non-disjunction means absence of sepration of two homologous X chromosomes during anaphse-I of meiosis. Both X-chromosomes go together to same pole. Other pole will receive no X-chromosome.
Thus (d) is correct option.

46. A colour blind mother and normal father would have
(a) colour blind sons and normal/carrier daughters
(b) colour blind sons and daughters
(c) all colour blind
(d) all normal

Ans : **DELHI 2005**

When a colour blind woman marries a normal man the recessive homozygous gene is expressed in sons whereas the daughters become carriers.



Thus (a) is correct option.

47. Out of 8 ascospores formed in Neurospora the arrangement is 2a : 4a : 2a showing
(a) No crossing over
(b) Some meiosis
(c) Second generation divison
(d) First generation division

Ans : **SQP 2009**

In neurospora, products of meiosis remain linearly arranged and undergo one mitosis. Crossing over occurs in four strand stage.
Thus (c) is correct option.

48. When a certain character is inherited only through female parent, it probably represents
(a) multiple plastid inheritance
(b) cytoplasmic inheritance
(c) incomplete dominane
(d) mendelian nuclear inheritance

Ans : **FOREIGN 2012**

Plasme genes present in the maternal cytoplasm are transmitted to offspring hence this type of inheritance is termed as cytoplasmic or maternal inheritance.
Thus (b) is correct option.

49. A polygenic inheritance is human beings is
(a) Skin colour
(b) Phnylketonuria
(c) Colour blindness
(d) Sickle cell anaemia

Ans : **OD 2024, COMP 2014**

Polygenic inheritance show cumulative effect i.e. two indepen-dent dominant genes produce additive effect on an individual.
Thus (a) is correct option.

50. Sex is determined in human beings
(a) by ovum
(b) at time of fertilization
(c) 40 days after fertilization
(d) seventh to eight week when genitals defferentiate in foetus

NODIA

Ans : **DELHI 2005**

Sex of human body is determined by the karyotype of the zygote of fertilized egg. sex of the baby depends upon the sperm which fertilizers the ovum.
Thus (b) is correct option.

51. Which crop variety is not due to induced muatations?
(a) Reimei of Rice
(b) Prabhat of Arhar
(c) Sharbati Sonora of Wheat
(d) Aruna of Castor

Ans : **DELHI 2010**

It was genetically modified to get high lipid contents.
Thus (d) is correct option.

52. A women with albinic father marries an albinic man. The proportion of her progeny is
(a) 2 normal : 1 albinic
(b) all normal
(c) all albinic
(d) 1 normal : 1 albinic

Ans : **COMP 2006**

The women is heterozygous as albinic condition is recessive hence when she marries an albinic man, the offsprings are 50% normal and 50% albinic.
Thus (d) is correct option.

53. Two dominat nonllelic genes are 50 map units apart. The linkage is
(a) cis type
(b) trans type
(c) complete
(d) absent/Incomplete

Ans : **SQP 2013**

Chromosome mapping is based on the fact that genes are linearly arranged on the chromosome and frequency of crossing over is directly proportional to the distance between two genes. Dominant genes show cis arrangement. At 50 map units cis is changed to trans & vice-versa hence no fixed linkage is present.
Thus (a) is correct option.

54. Which of the following is suitable for experiment on linkage
(a) aaBB × aaBB (b) AABB × aabb
(c) AaBb × AaBb (d) AAbb × AaBB

Ans : **FOREIGN 2020**

Due to linkage the genes present on same chromosome stay together during transmission. All other combinations except AABB × aabb show recombination which do not show linkage and hence not suitable for experiments on linkage.
Thus (b) is correct option.

55. Mr. Kapoor has Bb autosomal gene pair and d allele sex-linked. What shall be proportion of Bd in sperms
(a) Zero (b) 1/2
(c) 1/4 (d) 1/8

Ans : **DELHI 2005**

Genotype of Mr. Kapoor will be Bb d-hence one fourth of the sperms will have Bd.
Thus (c) is correct option.

56. The process of mating between closely related individuals is
(a) self breeding (b) inbreeding
(c) hybridisation (d) heterosis

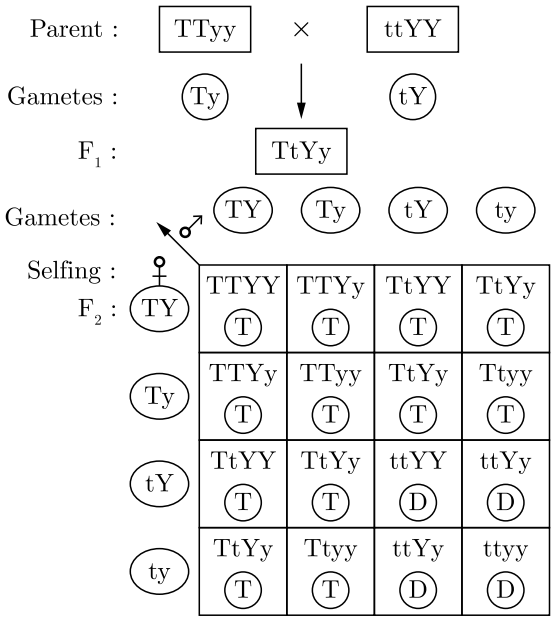
Ans : **OD 2024, 2009**

Inbreeding leads to the expression of recessive characters, most of the time which are harmful.
Thus (b) is correct option.

57. A cross between pure tall Pea plant with green pods and dwarf Pea plant with yellow pods will produce short F_2 plants out of 16
(a) 9 (b) 3
(c) 4 (d) 1

Ans : **DELHI 2012**

The two factors of each trait arrange or assort at random and are independent of each other in their distribution into the gametes and in the progeny.



Tall (T) - 12; Dwarf (D) - 4

Thus (c) is correct option.

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58. A fruitfly exhibiting both male and female traits is
(a) heterozygous (b) gynandromorph
(c) hemizygous (d) gynander

Ans : SQP 2013

A gynandromorph is an organism that contains both male and female chracteristics. These characteristics can be seen in butterflies, where both male and female characteristics can be seen physically because of sexual dimorphism. A gynandromorph can have bilateral symmetry, one side female and one side male or they can be mosaic, a case in which the two sexes aren't defined as clearly.
Thus (b) is correct option.

59. Genes located on Y-chromosome are
(a) mutant genes (b) sex-linked genes
(c) autosomal genes (d) holandric genes

Ans : FOREIGN 2016

Holandric genes are present on the differential region of the Y-chromosome. The differential regions carry completely sex linked genes and they do not undergo crossing over.
Thus (d) is correct option.

60. When two genetic loci produce identical phenotypes in cis and trans position, they are considered to be
(a) pseudoalleles
(b) different genes
(c) multiple alleles
(d) parts of same gene

Ans : COMP 2018

The pseudoalleles are two genetic loci producing identical phenotypes in cis as well as transposition.
Thus (a) is correct option.

61. Barr body in mammals represents
(a) all the heterochromatin in female cells
(b) Y-chromosomes in somatic cells of male
(c) all heterochromatin in male and female cells
(d) one of the two X-chromosomes in somantic cells of females

Ans : OD 2012

A barr body is one of the X-chromosomes in somatic cells of females. If there are more X-chromosomes, then there will be more barr bodies.
Thus (d) is correct option.

62. The polytene chromosomes were discovered for the first time in
(a) Drosophils (b) Chironomus
(c) Musca nebulo (d) Musca domestica

Ans : DELHI 2015

Polytec chromosomes are also called giant chromosomes. They consist of numerous parallel identical chromatids due to repeated duplication without division. They were first time observed by Balbiani in the salivary glands of chironomus.
Thus (b) is correct option.

63. The most striking example of point mutation is found in a disease called
(a) Thalassemia
(b) Night blindness
(c) Down's syndrome
(d) Sickle cell anaemia

Ans : SQP 2019

Sickle cell anaemia (in which nucleotide triplet CTC is changed to CAC) affects the $\beta-$globin chain of haemoglobin. Since these changes occur at a particular locus or point of a chromosome where specific gene is located, they are called as point mutation.
Thus (d) is correct option.

64. An individual exhibiting both male and female sexual characteristics in the body is known as
(a) Hermaphrodite (b) Intersex
(c) Gynandromorph (d) Bisexual

Ans : SQP 2005

Hermaphrodite or bisexual refers to an organism having both male and female sex organs. Gynandromorphs are individuals who exhibit both male and female characteristics.
Thus (c) is correct option.

65. The change of the light-coloured variety of peppered moth (Biston betularia) to its darker variety (Biston carbonarial to its darked variety (Biston carbonaria) is due to
(a) Mutation
(b) Regeneration
(c) Genetic isolation
(d) Temporal isolation

Ans : FOREIGN 2013

The change in the colour of peppered moth is due to the mutation of single medelian gene for the survival in the smoke-laden industrial environment. It is called Industrial melanism.
Thus (a) is correct option.

66. Alleles that produce independent effects in their heterozygous condition are called
(a) Codominant alleles
(b) Epistatic alleles

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(c) Complementary alleles
(d) Supplementary alleles

Ans : **COMP 2015**

Epistasis is the suppression of the normal phenotypic expression of the gene by non-allelic gene. Complimentary genes are two independent genes present on different gene loci which assist each other in expressing a trait. Supplementary genes are two independent genes present on different gene loci, each of which may produce its own trait and interact when present together in dominant state to produce a new trait.
Thus (a) is correct option.

67. A person with 47 chromosomes due to an additional Y chromosome suffers from a condition called
(a) Down's syndrome
(b) Superfemale
(c) Turner's syndrome
(d) Klinefelter's syndrome

Ans : **OD 2009**

Klinefelter's syndrome is formed by the union of an XX egg and a normal Y sperm or normal X egg and abnormal XY sperm. The individual has 47 chromosomes (44 + XXY).
Thus (d) is correct option.

68. A fruit fly is heterozygous for sex-linked genes. When mated with an normal female fruit fly, the male-specific chromosome will enter egg cells in the proportion of
(a) 1:1 (b) 1:2
(c) 3:1 (d) 7:1

Ans : **DELHI 2013**

In sex determination, the male specific chromosome will have half as much chance as the other to enter the egg cell.
Hence the proportion will be 1:1
Thus (a) is correct option.

69. H.J. muller was awarded nobel Prize for his
(a) discovery that chemicals can induce gene mutations
(b) discovery that ionizing radiations can induce gene mutations
(c) work on gene mapping in Drosophila.
(d) efforts to prevent the use of nuclear weapons.

Ans : **2010**

H.J. Muller- study of effect of radiation on the living organisms. He was awarded the nobel prize for discovering that ionizing radiations can induce gene mutations.
Thus (b) is correct option.

70. After crossing between two plants, the progenies are found to be male-sterile. This phenomenon is found to be maternally inherited and is due to some genes which are present in
(a) nucleus (b) chloroplast
(c) mitochondrion (d) cytoplasm

Ans : **SQP 2018**

Male sterlity occur due to cytoplasmic or cytoplasmic-genenic inheritance, i.e., due to DNA present in mitochondrion or chloroplast under the i.e. control of extra-nuclear gene.
Thus (d) is correct option.

71. Genetic identity of a human male is determined by
(a) autosomes (b) nucleolus
(c) sex chromosomes (d) cell organelles

Ans : **FOREIGN 2017**

Allosomes or sec chromosomes determine the sex of the individual. The rest of the chromosomes are known as autosome. Nucleolus is a cell organelle involved in synthesis of ribosomes.
Thus (c) is correct option.

72. The formation of multivalents at meiosis in a diploid organism is due to
(a) inversion
(b) deletion
(c) monosomy
(d) reciprocol translocation

Ans : **SQP 2006**

Inversion is a change in chromosomal architecture in which part of the chromosome gets inverted in its position so that the sequence of the genes in the inverted region is reversed. In deletion a segment of a chromosome breaks and is lost. Monosomy is a type of deletion involving deficiency of one chromosome (2n - 1). In reciprocal translocation there is a mutual exchange of segments between two non homologous chromosomes.
Thus (d) is correct option.

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73. Crossing over in diploid organism is responsible for
(a) segregation of alleles
(b) dominance of genes
(c) linkage between genes
(d) recombination of linked alleles

Ans : **DELHI 2010**

Crossing over involves physical exchange of

genetic material between non sister chromatids of homologous chromosomes, which leads to recombination.
Thus (d) is correct option.

74. How many genome types are present in a typical green plant cell?
(a) Two (b) Three
(c) More than five (d) More than ten

Ans : **OD 2008**

Three types of genome, occur in a typical green plant cell- nuclear genome, mitochondrial genome and chloroplast genome.
Thus (b) is correct option.

75. How many different types of genetically different gametes will be produced by a heterozygous plant having the genotype:
AABbCc ?
(a) Two (b) Four
(c) Six (d) Nine

Ans : **COMP 2010**

Different types of gametes produced will be ABC, AbC, ABc, Abc.
Thus (b) is correct option.

76. Molecular weigh of chromosome of yeast cell is
(a) 2.56×10^9 (b) 40×10^9
(c) 0.5×10^9 (d) 1×10^9

Ans : **COMP 2012**

Molecular weight of chromosome of yeast cell is 2.56×10^9.
Thus (a) is correct option.

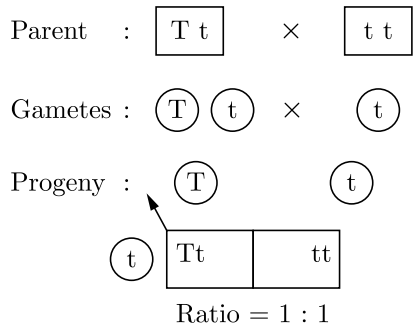
77. Which of the following is the main category of mutation?
(a) Genetic mutation (b) Zygotic mutation
(c) Somatic mutation (d) All of these

Ans : **OD 2013**

Somatic mutation is the mutation occurring in somatic or body cells. Mutations occurring in germ cells which are transferable to the progeny is called germinal mutation. Mutation occurring in genes is called genetic mutation.
Thus (a) is correct option.

78. In hybridisation Tt $\times$ tt gives rise to the progeny of ratio
(a) 1:1 (b) 1:2
(c) 2:1 (d) 1:2:1

Ans : **DELHI 2018**



Thus (a) is correct option.

79. Phenomenon of Industrial melanism demonstrates.
(a) natural selection
(b) induced mutation
(c) geographical isolation
(d) reproductive isolation

Ans : **SQP 2016**

During industrial revolution in England the frequency of melanic forms of species of Peppered Moth (Biston betularia) increased in polluted areas. Generally the moths are light coloured. This change in colour is known as Industrial melanism. The change was presumed to be a result of natural selection since the melanic moths better matched the blacked tree trunks where they rest during day.
Thus (a) is correct option.

80. How many base pairs are found in one genome of man?
(a) 7×10^4 (b) 2.8×10^7
(c) 3×10^9 (d) 4×10^9

Ans : **FOREIGN 2006**

The number of base pairs (bp) found in one genome of man is 3×10^9.
Thus (c) is correct option.

81. Mongoloid idiocy in humans is also known as
(a) Tay Sachs disease
(b) Klinefelter's syndrome
(c) Down's Syndrome
(d) Turner's Syndrome

Ans : **COMP 2008**

Downs syndrome develops due to trisomy of the 21^{st} chromosome. Affected individual possess a characteristic appearance. They have short stature, small round heads, broad forehead, open mouth and projecting lower lip (Mongoloid idiocy).
Thus (c) is correct option.

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82. Which character studied by Mendel in garden pea (pisum sativum) was dominant.
(a) Wrinkled seed shape
(b) Green pod colour
(c) Green seed colour
(d) Terminal flower position

Ans : OD 2010

Round seed shape is dominant over wrinkled. Yellow seed colour is dominant over green seed colour is dominant over green seed colour. Axial flower position is dominant over terminal.
Thus (b) is correct option.

83. When dominant and recessive alleles express itself together it is called
(a) codominance
(b) dominance
(c) amphidominace
(d) pseudodominance

Ans : DELHI 2013

According to principle of dominance, out of the two factors of alleles representing different traits of a character, only one expresses itself. But when both express themselves it is codominance.
Thus (a) is correct option.

84. Forthcoming generation are less adaptive than their parental generation due to
(a) natural selection (b) mutation
(c) genetic drift (d) adaption

Ans : SQP 2015

Natural selection operates through differential reproduction. Genetic drift is random change in the allele number and frequency in a gene pool.
Thus (b) is correct option.

85. Extranuclear inheritance occurs in
(a) peroxisome and ribosome
(b) chloroplast and mitochondria
(c) mitochondria and ribosome
(d) chloroplast and lysosome

Ans : FOREIGN 2018

In eukaryotic cells, two cytoplasmic organelles, mitochondria and chloroplast of green plants, contain their own genetic materials.
Thus (b) is correct option.

86. Probability of four sons to a couple is
(a) $\frac{1}{4}$ (b) $\frac{1}{8}$
(c) $\frac{1}{16}$ (d) $\frac{1}{32}$

Ans : COMP 2007

	(♀)		(♂)
Parents	XX	×	XY
XY	XX XX		XY XY
offsprings	daughters		sons

$$\text{probability of son}\frac{2}{4} = \frac{1}{2}$$
$$\text{probability of four son} = \left(\frac{1}{2}\right)^4 = \frac{1}{16}$$

Thus (c) is correct option.

87. A and B genes are linked what shall be genotype of progeny in a cross between AB/ab and ab/ab?
(a) AAbb and aabb (b) AaBb and aabb
(c) AABB and aabb (d) None of these

Ans : OD 2009

Parent : AB/ab × ab/ab

Gametes : (AB) (ab) × (ab)

F_1 :

	AB	ab
ab	AaBb	aabb

Thus (b) is correct option.

88. In humans, male XXY and female XXXX occur due to
(a) aneuploidy (b) euploidy
(c) autosomal syndrome (d) none of these

Ans : DELHI 2010

Aneuploidy is numerical change in the chromosome number in the genome. Euploidy is the phenomenon of having multiple or more than twice the number of genome.
Thus (b) is correct option.

89. Number of bar body present in each somatic cell of a female is
(a) 1 (b) 2
(c) 3 (d) 4

Ans : SQP 2011

One bar body is present in each somatic cell of female (XX).
Thus (a) is correct option.

90. Which of the following is an example of sex linked disease?
(a) AIDS (b) Colour blindness
(c) Syphilis (d) Gonorrhoea

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Ans : **FOREIGN 2014**

AIDS is a viral disease. Syphilis and gonorrhoea are both sexually transmitted diseases. Colour blindness is a sex linked disease.
Thus (b) is correct option.

91. In Drosophila, the sex is determined by
(a) Whether the egg is fertilized or develops parthenogenetically
(b) the ratio of number of X-chromosomes to the sets of autosomes.
(c) X and Y chromosomes.
(d) the ration of pairs of X-chromosomes to the pairs of autosomes.

Ans : **COMP 2015**

Calvin Bridges demonstrated that in Drosophila, the sex is determined by ratio of the number of X chromosomes to the sets of autosomes.
Thus (b) is correct option.

92. Genes for cytoplasmic male sterility in plants are generally located in
(a) Crytosol
(b) Chloroplast genome
(c) Mitochondrial genome
(d) Nuclear genome

Ans : **OD 2010**

Male sterility in plants can be controlled by nuclear genes or cytoplasm or by both. Three different mechanisms for control of male sterility in plants are:
1. Genetic male sterility
2. Cytoplasmic male sterility
3. Cytoplasmic genetic male sterility.

In Maize the genes for cytoplasmic control of male sterility are located in cytoplasm.
Thus (a) is correct option.

93. Which one of the following traits of garden pea studied by Mendel was a recessive feature?
(a) Round seed shape
(b) Axial flower position
(c) Green seed colour
(d) Green pod colour

Ans : **SQP 2005**

Yellow seed colour is dominant over green seed colour.
Thus (c) is correct option.

94. The genes controlling the seven pea characters studied by Mendel are now known to be located on how many different chromosomes?
(a) Four (b) Seven
(c) Six (d) Five

Ans : **COMP 2007**

The seven traits are now know to be present on four chromosome. But they do not show linkage, because of large distances between them on the chromosome.
Thus (a) is correct option.

95. Two crosses between the same pair of genotypes or phenotypes in which the source of the gametes are reversed in one cross, is known as
(a) Reverse cross (b) Test cross
(c) Reciprocal cross (d) Dihybrid cross

Ans : **OD 2009**

Dihybrid cross is made between individual OD ls having contrasting traits in order to study the inheritance of two pairs of alleles. Test cross is a back cross between individual with a dominant trait and its recessive parent to know whether the individual is homozygous or heterozygous for the trait.
Thus (c) is correct option.

96. Christmas disease is another name for
(a) Sleeping sickness
(b) Haemophilia
(c) Hepatitis B
(d) Down's syndrome

Ans : **DELHI 2018**

Christmas disease is another name of Haemophilia.
Thus (b) is correct option.

97. Pattern baldness, moustaches and beard in human males are examples of
(a) Sex-determining traits
(b) Sex linked traits
(c) Sex limited traits
(d) Sex differentiating traits

Ans : **SQP 2013**

Sex linked traits are those like colour blindness or haemophilia, which show criss-cross pattern of inheritance of certain genes together along with sex determining genes, because of their presence on the sex chromosomes. Sex limited characters express their effects only in one sex and not the other. Sex influenced characters appear due to the effect of particular sex hormone over different structures.
Thus (d) is correct option.

98. Lack of independent assortment of two genes A and B in fruit fly Drosophila is due to
(a) Repulsion (b) Recombination
(c) Linkage (d) Crossing over

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Ans : **FOREIGN 2014**

The lack of independent assortment in sweet pea and Drosophila is due to linkage.
Thus (c) is correct option.

99. The recessive genes located on X-chromosome in humans are always
(a) Lethal
(b) Sub-lethal
(c) Expressed in males
(d) Expressed in females

Ans : **DELHI 2015, SQP 2016**

Males have only one X-chromosome. Hence any gene present on the lone X-chromosome expresses itself in males. Females have two X-chromosomes. The mutant allele must be present on both the X-chromosomes to express itself phenotypically. If only one copy of allele present, then the female only becomes a carrier showing no external manifestation of the gene. Sublethal condition can never arise in males.
Thus (c) is correct option.

100. After a mutation at a genetic locus the character of an organism changes due to the change in
(a) Protein structure
(b) DNA replication
(c) Protein synthesis pattern
(d) RNA transcription pattern

Ans : **FOREIGN 2006, COMP 2008**

Change in genetic locus, changes the gene and in turn the amino acid it codes for. This alters the nature of protein synthesized which produces change in the organism. DNA replication is not affected neither the method of protein synthesis. Synthesis of RNA over DNA template is called transcription.
Thus (a) is correct option.

101. The salivary gland chromosomes in the dipteran larvae, are useful in gene mapping because:
(a) These are fused
(b) These are much longer in size
(c) These are easy to stain
(d) They have endoreduplicated chromosomes.

Ans : **OD 2009**

Polytene chromosomes were first reported by EG Balbiani in 1881. They are quite common in salivary glands of insects and are therefore popularly called salivary gland chromosomes. Polytene chromosomes also occur in other organs of insects antipodal cells (of embryo sac), endosperm cells and suspensor cell of embryo. The chromosomes can reach length of 200 μm and contain 1000 to 16000 times DNA as compared to the ordinary somatic chromosomes. The giant chromosomes are formed by somatic pairing between homologous chromosomes, and repeated replication (endomitosis) of their chromatids.
Thus (d) is correct option.

102. G-6-P dehydrogenase deficiency is associated with haemolysis of
(a) Leucocytes (b) Lymphocytes
(c) Platelets (d) RBCs

Ans : **DELHI 2010**

Glucose-6-P dehydrogenase is the first enzyme of glucose oxidation during Penrose Phosphate Pathway. RBC contain haemoglobin which combines with oxygen to form oxyhaemoglobin which gives its oxygen for oxidation of food. In haemolysis there is destruction of RBC's with release of haemoglobin into plasma resulting in juandice. So, now RBC's cannot provide oxygen for oxidation of food thereby causing deficiency of G-6-P dehydrogenase.
Thus (d) is correct option.

103. A women with 47 chromosomes due to three copies of chromosome 21 is characterized by:
(a) Superfemaleness
(b) Triploidy
(c) Turner's syndrome
(d) Down's Syndrome

Ans : **FOREIGN 2013**

Down's syndrome is caused by the presence of an extra chromosome number 21 and the off spring has 47 chromosomes.
Thus (d) is correct option.

104. If a colour blind woman marries a normal bisioned man, their sons will be
(a) One-half colour blind and one-half normal
(b) Three-fourths colour blind and one-fourth normal
(c) All colour blind
(d) All normal visioned

Ans : **COMP 2015**

Colour blindness in a X-chromosome linked character. So they'll be having all colour blind sons and carrier daughters.

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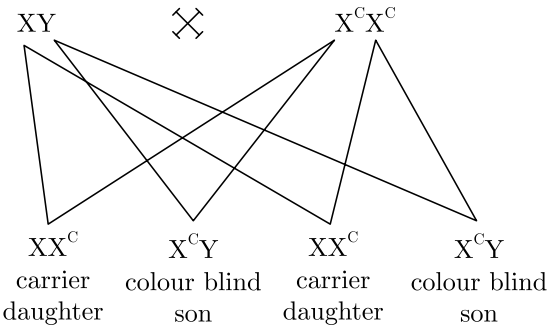

Thus (c) is correct option.

105. Which of the following is not a hereditary disease?
(a) Cystic fibrosis (b) Thalassemia
(c) Haemophilia (d) Cretinism

Ans : SQP 2011

Cystic fibrosis : It is a scommon disorder of caucasian race in which thick and more salty mucus blocks the respiratory tract. The homozygous recessive condition produces the defective proein which regulated chloride transport chennel.
Cretinism : In this disorder the physical growth, mental growth and sexual growth in children is retarded. Such a dwarf and sterile child is called a cretin. It is due to hyposecretion of thyroid hormones.
Thalassemia : Due to defective production of α or β chains of haemoglobin, autosomal recessive.
Haemophilia : Sex linked disorder due to defective recessive gene.
Thus (d) is correct option.

106. Which one of the following is an example of polygenic inheritance?
(a) Production of male honey bee
(b) Pod shape in garden pea
(c) Skin colour in humans
(d) Flower colour in Mirabilis jalapa

Ans : OD 2017

Polygenic inheritance is the inheritance of traits which are dependent on the number of genes such as the skin colour of human beings. eg. AABB is black AaBB in neither dark nor black. AaBb is again wheatish Aabb is light and aabb is white colour.
Thus (c) is correct option.

107. Cri-du-cha syndrome in humans is caused by the
(a) Loss of half of the short arm of chromosome 5.
(b) Loss of half of the long arm of chromosome 5.
(c) Trisome of 21^{st} chromosome.
(d) Fertilization of an XX egg by a normal Y-bearing sperm.

Ans : DELHI 2020

Cri-du-chat syndrome in humans caused by the partial deletion of the short arm of chromosome number 5. In this child has abnormalities in his/her facial expressions, mental retardation, speak like and they cry like that of cat, heart does not work properly.
Thus (a) is correct option.

108. Both sickle cell anemia and Huntington's chorea are
(a) Congenital disorders
(b) Pollulant - induced disorders
(c) Virus - related diseases
(d) Bacteria - related diseases

Ans : SQP 2021

Sickle cell anaemia is a biochemical disorder in which shape of RBC's become sickle-shaped due to the defective haemoglobin. Haemoglobin becomes useless for oxygen transport.
Huntington Chorea in a disease in which atrophy of brain occurs resulting to respiratory irregulations, articulation of speech and irregular limbs movements take place. They both are genetic disease present in any person since both birth hence congenital diseases.
Thus (a) is correct option.

109. Sickle cell anaemia has not been eliminated from the African population because
(a) It is not a fatal disease
(b) It provides immunity against malaria
(c) It is controlled by dominant genes
(d) it is controlled by recessive genes

Ans : FOREIGN 2013

In sickle cell anaemia RBCs become sickle shaped which are not supportive for the growth of malarial parasite Plasmodium so it provides immunity against malaria disease.
Thus (b) is correct option.

110. How many different kinds of gametes will be produced by a plant having the genotype AABbCC ?
(a) Four (b) Nine
(c) Two (d) Three

Ans : COMP 2016

It would make only two types of gametes, these are ABC & AbC.
Thus (c) is correct option.

111. The two polynucleotide chains in DNA are
(a) Discontinuous (b) Antiparallel
(c) Semi-conservative (d) Parallel

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Ans : **OD 2010**

The two chains are antiparalle, one aligned in 5' → 3' direction the other in 3' → 5' direction.
Thus (b) is correct option.

112. Point mutation involves :
(a) Change in single base pair
(b) Duplication
(c) Deletion
(d) Insertion

Ans : **DELHI 2007**

A point mutation is a simple change in one base of the gene sequence. this is equivalent to changing one letter in a sentence, such as this example, where we change the **e** in cat to an h :
Original : The fat cat ate the wee rat.
Point Mutation : The fat hat ate the wee rat.
Thus (a) is correct option.

113. The genotype of a plant showing the dominant phenotype can be determined by :
(a) Test cross (b) Dihybrid cross
(c) Pedigree analysis (d) Back cross

Ans : **SQP 2014**

Test cross is the cross of an individual with an individual having recessive phenotype. It is used to determine the genotype of a plant showing the dominant phenotype, that means to determine whether the individual exhibiting dominating characters are homozygous or heterozygous.
Thus (a) is correct option.

114. Infectious proteins are present in :
(a) Gemini viruses (b) Prions
(c) Viroids (d) Satellite viruses

Ans : **FOREIGN 2016**

Infections proteins are rich in prions. Prions are made of proteins without nucleic acid. It is the causal agent of scrapie disease of sheep.
Thus (b) is correct option.

115. When two unrelated individuals or lines are crossed, the performance of F_1 hybrid if often superior to both parents. This phenomenon is called.
(a) Heterosis (b) Transformation
(c) Splicing (d) Metamorphosis

Ans : **COMP 2018**

Heterosis or hybrid vigor occurs when two unrelated individuals or lines are crossed, the performance of F_1 hybrid, which is often superior to both is parents.
Thus (a) is correct option.

116. Mutations can be induced with :
(a) Infra red radiations
(b) I AA
(c) Ethylene
(d) Gamma radiations

Ans : **OD 2022**

Mutation can be induced by gamma radiation.
Thus (d) is correct option.

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117. Test cross in plants or in Drosophila involves crossing.
(a) Between two genotypes with recessive trait
(b) Between two F_1 hybrids
(c) The F_1 hybrid with a double recessive genotype.
(d) Between two henotypes with dominant trait

Ans : **DELHI 2009**

In test cross, genotype of an organism showing dominant phenotype is determined by crossing it with homozygous recessive genotype.
Thus (c) is correct option.

118. The unequivocal proof of DNA as the genetic material came from the studies on a
(a) Bacterium (b) Fungus
(c) Viroid (d) Bacterial virus

Ans : **SQP 2010**

Bacteriophage was used by Hershey and Chase to prove DNA as genetic material.
Thus (d) is correct option.

119. Which one of the following conditions of the zygotic cell would lead to the birth of a normal human female child?
(a) Two X chromosomes
(b) Only one Y chromosome
(c) Only one X chromosome
(d) One X and one Y chromosome

Ans : **FOREIGN 2013**

Two X chromosomes would lead to the birth of normal human female child.
Thus (a) is correct option.

120. A test is carried out to
(a) Determine the genotype of a plant at F2.
(b) Predict whether two traits are linked.
(c) Assess the number of alleles of a gene.
(d) Determine whether two species or varieties will breed successfully.

Ans : **COMP 2016**

A test cross, first introduced by Gregor Mendel, is used to determine if an individual exhibiting a

dominant trait is homozygous or heterozygous for that trait. It takes place between F1 - Generation and recessive parent.
Thus (a) is correct option.

121. Which Mendelian idea is depicted by a cross in which the F_1 generation resembles both the parents?
(a) Law of dominance
(b) Inheritance of one gene
(c) Co-dominance
(d) Incomplete dominance

Ans : **OD 2017**

In Co-dominance F_1 generation resemble both the parents. Ex : Blood group inheritance.
Thus (c) is correct option.

ASSERTION AND REASON

DIRECTION : Each of these questions contains as Assertion following by Reason. Read them carefully and answer the question on the basis of following options. You have to select the one that best describes the two statements.

122. Assertion : The genetic complement of an organism is called genotype.
Reason : Genotype is the type of hereditary properties of an organism.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **DELHI 2013**

Genotype of the organism include all dominant and recessive characters.
Thus (a) is correct option.

123. Assertion : Phenylketonuria is a recessive hereditary disease caused by body's failure to oxidize an amino acid phenylalanine to tyrosine, because of a defective enzyme.
Reason : It results in the presence of phynylalanine acid in urine.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **SQP 2015**

Phenylketonuria is an recessive autosomal gene disorder. It occurs due to the absence of enzyme phenylalanine hydroxylase which changes phenylalanine to tyrosine.
Thus (b) is correct option.

124. Assertion : In humans, the gamete contributed by the male determines whether the child produced with be male or female.
Reason : Sex in humans is a polygenic trait depending upon a cumulative effect of some genes on X-chromosome and some on Y-chromosome.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **FOREIGN 2006, COMP 2010**

In humans, sex of a child depends upon the gametes produced by the male (X, Y).
Thus (c) is correct option.

125. Assertion : Haemophilia is a recessive sex linked disease.
Reason : Haemophilia occurs due to mutation of a structural gene on chromosome 15.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **OD 2010**

Haemophilia also known as bleeder disease is an example of recessive sex linked inheritance in human beings. It is masked in heterozygous condition. The person suffering from this disease lack factors VIII and IX responsible for blood clotting. A small cut may lead to bleeding till death. Men are affected by this disease while women are the carriers.

Mutation of a structural gene on chromosome number 15 causes Marfan syndrone. This disease results in formation of abnormal form

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of connective tissues and characteristic extreme loosseness of joints.
Thus (c) is correct option.

126. Assertion : Persons suffering from haemophilia fail to produce blood clotting factor VIII.
Reason : Prothrombin producing platelets in such persons are found in very low concentration.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **DELHI 2015**
Haemophilia bleeding disorder is a group of hereditary genetic disorders that impair the body's ability to control blood clotting or coagulation. In its most common form, Hemophilia A, clotting factor VIII is absent. In Haemophilia B, factor IX is deficient. Factor VIII participates in blood coagulation; it is a cofactor for factor IXa which, in the presence of Ca^{+2} and phospholipids forms a complex that converts factor X to the activated form Xa. Defects in this gene results in hemophilia A, a common recessive X-linked coagulation disorder, Prothrombin producing platelets in such persons are not found in very low concentration.
Thus (c) is correct option.

127. Assertion : In case of incomplete linkage, linked gene show new combination along with parental combination.
Reason : In case of incomplete linkage, linked genes are separated by crossing over.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **SQP 2010**
In case of incomplete linkage, the linked gene shows new combination along with parental combination due to crossing over between chromatids.
Thus (a) is correct option.

128. Assertion : Aneuploidy may be of hypoploidy or hyperploidy type.
Reason : Monosomy lackes one pair of chromosomes.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **FOREIGN 2013**
Aneuploidy can be either due to loss of one of more chromosomes (hypoploidy) or due to addition of one or more chromosomes to complete chromosome complement (hyperploidy). Hypopliody is mainly due to loss of a single chromosomes, monosomes $(2n-1)$ or due to loss of one pair of chromosomes, nullisomes $(2n-2)$.
Thus (c) is correct option.

129. Assertion : Cross of F_1 individual with recessive homozygous parent is test cross.
Reason : No recessive individual are obtained in the monohybrid test cross.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **COMP 2016**
In the monohybrid test-cross both dominant and recessive traits are obtained in 1 : 1 ratio.
Thus (c) is correct option.

130. Assertion : In Mirabilis, selfing of F_1 pink flower plants produces same phenotypic and genotypic ratio.
Reason : Flower colour gene shows incomplete dominance.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **OD 2012**
F_2 phenotypic and genotypic ratio in monohybrid cross involving incomplete dominance is

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1	:	2	:	1
RR		Rr		rr
(red)		(pink)		(white)

Thus (a) is correct option.

131. **Assertion :** In humans, the gamete contributed by the male determines whether the child produced will be male or female.
Reason : Sex in humans is a polygenic trait depending upon a cumulative effect of some genes on X-chromosome and some on Y-chromosome.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : DELHI 2008
In human, the gamete contributed by the male determines whether the child produced will be male or female. Sex in humans is a polygenic trait depending upon cumulative effect of some genes present on Y-chromosome. Only sex in human is amonogenic trait.
Thus (c) is correct option.

VERY SHORT ANSWER QUESTIONS

132. A garden pea plant produced round, green seeds. Another of the same species produced wrinkled, yellow seeds. Identify the dominant traits.

Ans : SQP 2015
Round seeds and yellow seeds.

133. Why are gametes said to be pure for a character?

Ans : FOREIGN 2018
Gametes are pure for a character because they are always haploid. During gamete formation, alleles of a pair segregate such that a gamete receives only one allele for a character.

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134. Differentiate between Dominance and Recessive.

Ans : COMP NCERT

Dominance	Recessive
Dominance refers to the phenomenon exhibited by the form of a trait, which expresses itself in the heterozygous (hybrid condition.)	Recessive refers to the phenomenon exhibited by the form of a trait, which remains suppressed or hidden in the heterozygous (hybrid) condition.

135. Differentiate between Homozygous and Heterozygous.

Ans : OD 2011

Homozygous	Heterozygous
It is the condition in which the members of a pair of alleles for a character are similar.	It it the condition in which are members of a pair of alleles for a character are different.

136. Differentiate between Monohybrid and Dihybrid.

Ans : DELHI 2015

Monohybrid	Dihybrid
It is the individual that is heterozygous for the alleles (of a gene) controlling one character/trait.	It is the individual that is heterozygous for the alleles (of two genes) controlling two characters/traits.

137. Name the respective pattern of inheritance where F_1 - phenotype
(i) does not resemble either of the two parents and is in between the two.
(ii) resembles only one of the two parents.

Ans : All India 2012
(i) Incomplete dominance
(ii) Dominance

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138. List any two characters of pea plants used by Mendel in his experiments other than height of the plant and the colour of the seed.

Ans : DELHI 2017C
The two characters of pea plant used by Mendel in his hybridisation experiment are
(i) Flower colour - violet and white
(ii) Pod colour - Green and yellow

139. A garden pea plant (A) produced inflated yellow pod and another plant (B) of the same species

produced constricted green pods. Identify the dominant traits.

Ans : **DELHI 2012**

The dominant traits are

(i) For pod shape - Inflated (or full)

(ii) For pod colour - Green

140. Write an example where Punnett square can be effectively used.

Ans : **SQP 2013**

Punnett square can be effectively used to understand the independent segregation of the two pairs of genes during meiosis.

141. State a difference between a gene and an allele.

Ans : **All India 2016**

A factor (characteristic) which is passed down from parent to offspring through gametes over successive generation is called a gene. Genes contain a pair of constrasting forms known as alleles.

142. In order to obtain the F_1-generation, Mendel pollinated a pure-breeding tall plant with a pure-breeding dwarf plant. But for getting the F_2-generation, he simply self-pollinated the tall F_1 - plants . Why?

Ans : **FOREIGN 2010**

Characters segregate during gamete formation. Pure-breeding parents give rise to F, with heterozygous conditions. Only self-pollination of heterozygous can result in all possible recombinations of characters in progeny as mating is random.

143. Write the percentage of F_2-homozygous and heterozygous populations in a typical monohybrid cross.

Ans : **FOREIGN 2010**

In a typical mono-hybrid cross, the percentage of homozygous and heterozygous population is 50% each.

144. Write the percentage of the pea plants that would be heterozygous tall in the F_2-generation, when tall heterozygous F_1 pea plants are selfed.

Ans : **SQP 2005**

50%

145. Mention the type of allele that expresses itself only in homozygous state in an organism.

Ans : **COMP 2010**

Recessive allele

146. Mention any two contrasting traits with respect to seeds in pea plant that were studied by Mendel.

Ans : **All India 2014**

Mendel utilised two characters of seed in pea plants. These two characters and their contrasting traits are as under

(i) Seed shape - Round and wrinkled

(ii) Seed colour - Yellow and green

147. Name and state the law of Mendel, which explains the expression of only one of the parental characters in the F_1-generation of a monohybrid cross.

Ans : **OD 2009**

Law of dominance states that when two individuals of a species, differing in a pair of contrasting characters are crossed, the character which appears in the F, hybrid is said to be dominant over the trait that remains hidden.

148. Name the type of cross that would help to find the genotype of a pea plant bearing violet flowers.

Ans : **All India 2017**

Test criss.

149. Law of independent assortment was based on which observations of Mendel?

Ans : **SQP 2011**

It is based on the observations of dihybrid crosses (crosses between plants differing in two traits).

150. Which law of inheritance of Mendel is universally acceptable and without any exception? State the law.

Ans : **DELHI 2012**

Law of segregation states that the members of the allelic pair that remained together in the hybrid, segregate or separate during gametogenesis and enter different gametes.

151. Why in a test cross, did Mendel cross a tall pea plant with a dwarf pea plant only?

Ans : **SQP 2005**

Dwarfness is a recessive trait which is expressed only in homozygous condition, so he was sure of the genotype of the dwarf plant as tt.

152. AaBb was crossed with aabb. What would be the phenotypic ratio of the progeny? Mention the term to denote this kind of cross.

Ans : **FOREIGN 2007**

1 AaBb 1 Aabb : 1 aaBb : 1 aabb.

It is a test cross.

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153. The gene I that controls the ABO blood grouping in human beings has three alleles I^A, I^B and i.
(i) How many different genotypes are likely to be present in the human population?
(ii) Also, how many phenotypes are possibly present?
Ans : **COMP 2009**
(i) Six (ii) Four

154. Multiple allelism can be investigated only in populations. Justify.
Ans : **OD 2012**
Though a gene exists in more than two allelic forms, in multiple allelism, a person can have only two of those alleles, as he has only two sets of homologous chromosomes, so multiple allelism can be studied only in a population.

155. Give an example of polygenic trait in humans.
Ans : **DELHI 2016**
An example of polygenic trait in human is skin colour. It is because, its under the control of many genes.

156. How does the strength and weakness of linkage depend on linked genes?
Ans : **SQP 2013**
The strength of linkage increases as the distance between two linked genes decreases. The linkage becomes weaker with the increase in the distance between genes.

157. How many pairs of chromosomes does a male Drosophila fly have?
Ans : **FOREIGN 2015**
Four pairs.

158. A diploid organism is heterozygous for 4 loci, how many types of gametes can be produced?
Ans : **COMP 2012**
The formula 2^n is applied here
where, n = Number of loci
The organism is heterozygous for 4 loci, $n = 4$
So,

$$2^n = 2^4 = 2 \times 2 \times 2 \times 2 = 16$$

The organism will produce 16 types of gametes.

159. If the frequency of a parental form is higher than 25% in a dihybrid test cross, what does that indicate about the two genes involved?
Ans : **OD 2013**
They show linkage.

160. Why do certain genes tend to be inherited together in a cell at the time of cell division?
Ans : **DELHI 2015**
They show a phenomenon called linkage.

161. In Drosophila, 2n = 8; how many linkage groups are present in it?
Ans : **SQP 2018**
Four

162. Name the sex-determination mechanism in following
(i) Mammals (ii) Birds
Ans : **FOREIGN 2019**
(i) Mammals-XX-XY type.
(ii) Birds-ZZ-ZW type.

163. Write the chromosomal basis of sex-determination in birds.
Ans : **DELHI 2016**
Birds have ZW-ZZ type of sex-determination.

164. Give one example of organism exhibiting female heterogamety.
Ans : **All India 2016**
Birds show female heterogamety.

165. Give one example where males are XO.
Ans : **COMP 2005**
Grasshopper

166. Give an example each of the following cases, where
(i) the sperm is responsible and
(ii) ovum is responsible for the sex-determination.
Ans : **COMP 2008**
(i) Human beings/Drosophila
(ii) Birds (fowls)

167. Why is X-chromosomes called sex-chromosome?
Ans : **OD 2010**
Since X-chromosome is involved in the determination of sex of an individual, it is called sex-chromosome.

168. How many X-chromosomes and how many autosomes are present in a human ovum?
Ans : **DELHI 2011**
One X-chromosome and 22 autosomes.

169. Who first observed the X-chromosome? What was it called then?
Ans : **SQP 2014**
Henking first observed X-chromosome. It was called
X-body.

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170. How many chromosomes do drones of honeybee possess? Name the type of cell division involved in the production of sperms by them.

Ans : **All India 2015**

Drones of honeybee possess 16 chromosomes (haploid). They produce sperms by a mitosis like division, rather than by meiosis.

171. Give an example of an organism that exhibits haplo-diploidy sex-determination system.

Ans : **DELHI 2017**

Haplo-diploidy sex-determination system is seen in grasshoppers.

172. State the fate of a pair of autosome during gamete formation.

Ans : **DELHI 2017**

During gamete formation, the homologous pair of autosomes gets separated from each other and moves to different gametes, so that each gamete receives haploid set of chromosomes.

173. What is meant by chromosomal mutation?

Ans : **FOREIGN 2016**

A change in the structure and/or number of chromosome in an organism is called chromosomal mutation.

174. Name one autosomal dominant and one autosomal recessive Mendelian disorder in humans.

Ans : **All India 2010**

Autosomal dominant disorder - Huntington disease

Autosomal recessive disorder - Sickle-cell anaemia

175. Give an example of a sex-linked recessive disorder in humans.

Ans : **DELHI 2016C**

Haemophilia is sex-linked recessive disorder in humans.

176. A colourblind boy is born to a couple with a normal colour vision. Write the genotype of the parents.

Ans : **All India 2017C**

X'Y (colourblind boy)

Its parent could be XX^C: (carrier mother)and XY (normal father)

177. A change in the amino acid at the sixth position in the beta globin chain leads to sickle-cell anaemia. Name the amino acid that has changed and the new amino acid.

Ans : **COMP 2020**

Glutamic acid is changed to valine.

178. Why do the males suffer more from haemophilia than females?

Ans : **OD 2024, 2023**

The gene for haemophilia is located on X-chromosome. So in males, single gene for the defect is able to express, that is why males suffer from haemophilia more than female.

179. Write the genotype of

(i) an individual, who is carrier of sickle-cell anaemia gene but apparently unaffected and

(ii) an individual affected with the disease.

Ans : **All India 2010**

(i) Hb^AHb^s

(ii) Hb^SHb^s

180. State the reasons of chromosomal disorders.

Ans : **COMP 2005**

Chromosomal disorders are caused due to excess, absence or abnormal arrangement of one or more chromosomes.

181. Why are the products of phenylalanine catabolism excreted in the urine in phenylketonuria?

Ans : **DELHI 2008**

This is because it is poorly absorbed by kidneys.

182. Name the metabolism/enzyme that is impaired in phenylketonuria.

Ans : **SQP 2009**

The enzyme that converts phenylalanine into tyrosine.

183. In which type of cells are chromosomal aberrations commonly found?

Ans : **FOREIGN 2012**

Cancerous cells.

184. Who proposed the chromosomal theory of inheritance?

Ans : **DELHI 2011**

Walter Sutton and Theodore Boveri proposed the chromosomal theory of inheritance in 1902.

185. A human being suffering from Down's syndrome shows trisomy of 21st chromosome. Mention the cause of this chromosomal abnormality.

Ans : **COMP 2015**

This is due to failure of segregation of homologous chromosomes during gamete formation.

186. Name the disorder caused due to the absence of one of the X-chromosomes in a human female.

Ans : **OD 2018**

Turner syndrome is 45 with XO.

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187. What are barr bodies?

Ans : **DELHI 2013**

The inactive X- chromosome in karyotype of Klinefelter syndrome.

188. What do letter F_1 and F_2 represent in heredity studies?

Ans : **SQP 2010**

F_1 - Filial progeny 1, F_2 - Filial progeny 2.

189. In Drosophila with $2n = 8$, how many linkage groups are present in it?

Ans : **COMP 2005**

4

190. Who experimentally verified the chromosomal theory of inheritance proposed by Sutton and Theodor Boveri?

Ans : **FOREIGN 2006**

Thomas Hunt Morgan

191. What is a monosomic condition?

Ans : **COMP 2012**

It is a form of aneuploidy with the presence of only chromosome from a pair.

SHORT ANSWER QUESTIONS

192. What do you mean by Incomplete dominance? Explain with suitable example.

Ans : **OD 2018**

The incomplete dominance is the exception of mendel's first law of dominance. In it, none of the two contrasting alleles is dominant and the character expressed in F_1 generation is intermediate or mixture of contrasting alleles. The famous example of this phenomenon was reported by Carl correns in 1903 in Mirabilis Jalapa (4 O'clock) Plant. When its white flowered variety ($r\,r$) is crossed with red flowered variety (RR) The resulting progeny then in F_1 generation have pink colored flower. Which is intermediate of these two colors showing that none of the trait is completely dominant over another.

193. Write the functions of blood.

Ans : **OD 2017**

Blood is red coloured fluid connective tissue. It is formed of plasma and Blood cells (RBC, WBC and platelets).

The junctions of Blood are as follows :

1. Blood plasma helps in the transport of nutrients, hormones, vitamins etc to every part of the body. It also helps to maintain body temperature, water balance and pH of the body.
2. Red Blood Cells (RBC) help in transport of respiratory gases (O_2 and CO_2) from lungs tissues and back.
3. White Blood Cells (WBC) help to fight diseases by destroying foreign pathogen/ antigen by producing antibodies and antitoxins.
4. Blood platelets help in clotting of blood at injured areas.

194. Write about multiple allelism with suitable example.

Or

What are multiple alleles?

Ans : **OD 2010, DELHI 2014**

Multiple alleles are more than two alternative forms of a gene present in the same gene locus that controls a single character. It is derived by the mutation of wild type gene Characteristics of multiple alleles are as follows.

1. There are more than two alternative forms of a gene for a single character. Example eye colour of fruit fly has 15 alleles.
2. All the multiple alleles are located on the same gene locus on the same chromosome.
3. They do not undergo crossing over because they all lie in the same locus.
4. Each trait consists of two similar or dissimilar alleles but gamete has single allele.

Example- ABO blood group in human beings. A set of three multiple alleles (I^A, I^B and i) present on chromosome q is responsible for four blood types (A, B, AB and O) in humans.

195. Write Mendel's law based on monohybrid cross.

Ans : **OD 2015**

On the basis of conclusions derived from monohybrid cross, Mendel proposed following two laws.

1. **Law of Dominance :** It states that F_1 -generation always display only one of the parental traits. He described that trait which was always seen in F_1-generation as dominant and the trait that disappeared as recessive.
2. **Law of Segregation :** It is also called law of purity of gametes. This law states that members of each pair of alleles of a gene separate when gametes are produced in meiosis.

Mendel's law of segregation is universal and without any exception.

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3. It is due to the inter-relationship between different metabolic pathways.

224. Linkage and crossing over of genes are alternatives of each other. Justify with the help of an example.

Ans : **COMP 2012**

1. Linkage refers to the physical association of two or more genes present on a chromosome that are always inherited together.
2. Crossing over refers to the exchange of equivalent segments between non-sister chromatids of homologous chromosomes, leading to recombination of genes.
3. If the linkage is stronger, the frequency of crossing over and recombination is less and vice versa.
4. In any case, when the phenomenon of linkage is present, the recombination frequency of the two genes involved is less than the 50% expected in a test cross progeny.

225. Bring out the differences between multiple genes and multiple alleles.

Ans : **DELHI 2009**

The difference between multiple genes and multiple alleles.

	Multiple genes	**Multiple alleles**
1.	The character is controlled by more than one gene.	The character is controlled by a single gene.
2.	Each gene exists in two allelic forms.	The gene exists in more than two allelic forms.
3.	The phenotype is produced by the cumulative or additive effect of all the genes.	The alleles may be dominant, recessive and codominant.
4.	The hybrid is intermediate between the two parents.	The hybrid resembles both the parents.

226. When the relative frequency of the different phenotypes of a cross is plotted graphically, a bell-shaped curve results. Mention any four characteristics of such a pattern of inheritance.

Ans : **FOREIGN 2005**

The characteristics of such an inheritance are as follows :

1. The character is controlled by more than one gene, i.e., polygenic.
2. The expression of a trait is the manifestation of the number of alleles contributing to it, i.e., it is a quantitative inheritance.
3. There are only a few individuals that show the parental traits.
4. The F_1 hybrid is intermediate between the two parents.

227. Differentiate between male heterogamety and female heterogamety.

Ans : **OD 2007**

The difference between male heterogamety and female heterogamety are as follows :

	Male heterogamety	**Female heterogamety**
1.	It is the phenomenon in which the male produces two types of sperms, with reference to the sex-chromosomes.	It is the phenomenon in which the female produces two types of ova, with reference to the sex- chromosome.
2.	The sex of the offspring is determined by the type of sperm fertilising the ovum.	The sex of the offspring is determined by the type of ovum that is fertilized.

228. Explain the mechanism of sex determination in birds.

Ans : **SQP 2012**

The mechanism of sex determination in birds are as follows :

1. Birds have ZW type of sex determination.
2. The females have ZW chromosomes and are heteroametic, i.e. 50% of the ova possess Z-chromosome while the other 50% possess W-chromosome with the autosomes.
3. The males have ZZ chromosomes and are homogametic, i.e. all the sperms carry one Z-chromosome, each with the autosome.
4. Sex of the bird is determined at the time of fertilization by the type of ovum, that is fertilized;
5. If the ovum carrying Z-chromosome is fertilized, a ZZ individual (male) results.
6. If the ovum carrying W chromosome is fertilized, a ZW individual (female) results:

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chromosomes during meiosis (Prophase I, diplotene stage), which results in new allelic combinations in the daughter cells.
The process of crossing over can be mainly divided into stages.

1. **Synapsis :** Inprophas-I of meiosis homologous chromosomes pair lengthwise. The pairing starts at one or more points and proceeds along the whole length in a zipper fashion. The process of pairing is called synapsis. The paired homologous chromosomes are called bivalents. The two homologous chromosomes are held together by a synaptqnemal complex.
2. **Duplication of chromosomes :** Synapsis is followed by the duplication of chromosomes which changes the bivalent nature of chromosome to four standerd tetravalent stage it occurs due to splitting of homologous chromosomes into sister chromatids attached with un-splitted centromeres.
3. **Crossing-over :** In pachytene stage crossing over takes place. Non-sister chromatids of homologous pair twist over each other due to action of enzyme endonuclease. The chromatids get connected with each other at points known as chiasmata. The crossing over take place at several points. The number of chiasmata formed is proportional to the length of chromatids. The genes at distant loci undergo crossing-over but closely placed genes fail to cross-over and exhibit the phenomenon of linkage.
4. **Terminalisation :** During diakinesis of prophase-I chiasmata move towards the end of bivalent by a process called terminalization. Thus twisting chromatids separate so that the homologous chromosomes are separated completely.

202. Explain briefly how an XXY individual is produced in humans.

Ans : **OD 2010**

Persons with karyotype 45 + XXY are said to be suffering from klinefelter's syndrome. It is a chromosomal disorder that is caused by the presence of an additional copy of X-Chromosome in an individual.

In this disorder sex of the individual is masculine but possess feminine characters also. The individual show gynaecomastia, i.e., development of breasts. The individual will be often sterile having poor beard growth and feminine pitched voice.

203. Why did Mendel select pea as his experimental material ?

Ans : **OD 2009**

Medal selected garden pea as his experimental material due to following reasons:

1. Pea plants were readily available and easy to be raised and handled.
2. Pea are bisexual plants, they can be self-pollinated and can be cross-pollinated also.
3. These are annual plants with short life cycle.
4. Pea plants differ in distinct characteristics, which provide many easily detectable contrasting characters.

204. What do you think he (Mendel) would have got, had he self-pollinated a tall F_2 plant?

Ans :

If the tall plant he had self-pollinated were homozygous, i.e. of genotype TT, he would have got all tall plants in the F_3.
If the tall plant he had self-pollinated were heterozygous, i.e. of genotype Tt, he would have got the following types of plants.

Parents : Tall (Tt) × Tall (Tt)

Gametes : (T, t) (T, t)

F_3 Progeny : T t

	T	t
T	TT Tall	Tt Tall
t	Tt Tall	tt Dwarf

He would have got tall and dwarf plants in the ration 3 : 1.

205. 1. Using a Punnet square, try to find out the nature of offspring in a test cross.
2. What ratio do you get?
3. Using the genotypes of this cross, can you give a general defiintion of a test cross?

Ans : **COMP 2005**

1. A cross between a homozygous dominant individual and a homozygous recessive individual

Parents : AA × aa

Gametes : (A) (a)

Progeny : Aa

All individual in the progent will be tall.

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The child has O blood group, whose genotype is homozygous recessive 2., where one allele has come from each of the parents.
So, both the parents must be heterzygous for the blood group character.

Parents : Father A blood group $\times$ Mother B blood group

I^Ai $\times$ I^Bi

Gametes : I^A, i and I^A, i

Progeny :

	I^A	i
I^B	I^AI^B AB-blood group	I^Bi B-blood group
i	I^Ai A-blood group	ii O-blood group

The progeny/offspring may have blood groups A, B or AB also, apart from O.

215. Explain the following terms with example.

1. Co-dominance
2. Incomplete diminance

Ans : **FOREIGN 2018**

1. Co-dominance is the phenomenon in which two alleles of a gene are equally dominant and express themselves in the presence of the other when they are together in an individual, e.g. blood group AB- in this the alleles I^A and I^B are codominant and both express themselves producing the glycoproteins A and B, making the blood group AB.
2. Incomplete dominance is the phenomenon in which neither of the two alleles of a gene is completely dominant over the other and the hybrid is intermediate between the two parents, e.g. flower colour in snapdragon, the homozygous dominant is red-flowered, the homozygous recessive is white flowered and the hybrid is pink-flowered.

216. What is point mutation? Give one example.

Ans : **DELHI 2019**

Point mutation refers to the mutation arising due to a change in a single base pair of DNA, e.g. sickle cell anaemia.

1. The defect is caused by a single base substitution at the sixth codon (GAG to GUG) of the gene coding for beta globin chain.
2. Consequently, amino acid, glutamic acid is substituted by valine at the sixth position of the beta globin protein.

217. Mention any two autosomal genetic disorders with their symptoms.

Ans : **SQP 2019**

1. Sickle cell Anaemia
   (a) It is an autosomal recessive disorder controlled by a single pair of allele Hb^A and Hb^S.
   (b) Individuals with genotype Hb^SHb^S are the victims while those with Hb^AHb^S are the carriers of the disease;
   (c) The mutant haemoglobin undergoes polymerisation under low oxygen pressure and causes change in the RBCs from biconcave disc to elongated sickle-shaped structure.
2. Phenylketonuria
   (a) It is caused by a recessive mutant allele on chromosome 12.
   (b) The affected individuals lack an exzyme that catalyses the conversion of the amio acid phenylalanine into tyrosine.
   (c) As a result, phenylalanine is metabolised into phenyl pyruvate, phenyl acetate, etc.
   (d) Accumulation of these chemicals in the brain results in mental retardation.
   (e) These are also excreted in the urine, as they are not absorbed by the kidney tubules.

218. With the help of a Punnett Square, find the percentage of heterozygous individuals in a F_2 population of a cross involving a true-breeding pea plant with green pods and a true-breeding pea plant with yellow pods, respectively.

Ans : **FOREIGN 2005**

The cross is as follows:

Parents : Green pods $\times$ Yellow pods

GG $\times$ gg

Gametes : G and g

F_1 generation : Gg (Green pods)

Selfing : Gg $\times$ Gg

Gametes : G, g and G, g

F_2 generation : G and g

	G	g
G	GG Green Pods	Gg Green Pods
g	Gg Green Pods	gg Yellow Pods

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Dominant phenotype : Recessive phenotype = 1 : 1

Cross II (Where the female is homozygous dominant)

Parents : Homozygous female × Heterozygous male

BB × Bb

Gametes : (B) (B) (b)

Progeny :

	B
B	BB Dominant phenotype
b	Bb Dominant phenotype

All the individuals in the progeny show dominant phenotype.

209. When a cross is made between a tall plant with yellow seeds (TtYy) and a tall plant with green seeds (Ttyy), what proportions of phenotype in the offspring could be expected to be :

1. tall and green.
2. dwarf and green.

Ans : **FOREIGN 2015**

Parents : Tall, yellow TtYy × Tall, green Ttyy

Gametes : (TY) (Ty) (tY) (ty) (Ty) (ty)

Progeny :

	TY	Ty	tY	ty
Ty	TTYy Tall, yellow	TTyy Tall, green	TtYy Tall, yellow	Ttyy Tall, green
ty	TtYy Tall, yellow	Ttyy Tall, green	ttYy Dwarf, yellow	ttyy Dwarf, green

1. Tall and green : 3/8
2. Dwarf and green : 1/8

210. Two heterozygous parents are crossed. If the two loci are linked, what would be the distribution of phenotypic features in F_1 generation for a dihybrid cross?

Ans : **OD 2014**

1. If the loci show complete linkage, all the offspring will be of the parental types only.
2. If the loci show incomplete linkage, the parental types and recombinations would appear in the progeny, but the recombination will be in a small proportion.
3. If the linked loci are far apart, the progeny will show Mendelian dihybrid ratio, i.e. 9 : 3 : 3 : 1.

211. Briefly mention the contribution of T.H. Morgan in genetics.

Ans : **DELHI 2015**

Morgan conducted experiments on Drosophila and discovered sex-linked inheritance of traits. He also found that linked genes may show a phenomenon called linkage, the genes that are tightly linked, showed very low recombination frequency, while those that are loosely linked showed a higher recombination frequency, but less than 50% in a test progeny.

212. What is pedigree analysis? Suggest how such an analysis, can be useful.

Ans : **SQP 2016**

Pedigree analysis is an analysis of the distribution and movement of traits in a series of generations of a family. It is an important method to study human genetics. Genetic disorders occurring in a family can be identified and the movement of the trait in the future generations can be predicted.

213. How is determined in human beings?

Ans : **COMP 2017**

1. A human female (mother) produces ove, all containing one X-chromosome and 22 autosomes.
2. A human male (father) produces sperms of two types- 50% of them carrying one X-chromosome and 22 autosomes.
3. The sex of the child is determined by the type of sperm fertilizing the ovum.
4. If the ovum is fertilized by a sperm carrying X-chromosome, a female child results.
5. If the ovum ferlilized by a sperm carrying Y-chromosome, a male child is formed.

Parents : Female XX × Male XY

Gametes : (X) (X) (Y)

Progeny :

	X	Y
X	XX Female	XY Male

214. A child has blood group O. If the father has blood group A and has blood group B, workout the genotypes of the parents and the possible genotypes of the offsprings.

Ans : **OD 2018**

Man (A blood group) × Woman (B blood group)

Child (O blood group)

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A cross between a heteozygous individual with a homozygous recessive individual

Parents : Aa × aa

Gametes : (A) (a) (a)

F_3 generation :

	A	a
a	Aa	aa

The progeny will consist of individuals of dominant phenotype and those of recessive phenotype will be in equal proportions.

2. The ration is 1:1 in the second cross.
3. A test cross is a cross in which an individual with dominant phenotype, but unknown genotype is crossed with homozygous recessive individual of the same species.

206. Explain the law of Dominance using a monohybrid cross.

Ans : **COMP 2014**

1. Law of dominance states that dominace is a phenomenon, in which one allele of a gene expresses itself and suppresses the expression of the other allele of the sae gene, when they are present together in a hybrid.
2. When a cross was made between two individuals, one with tall stem (homozygous) and the other with dwarf stem, the F_1 individuals had tall stem.
3. When an F_1 individuals is self-pollinated, the F_2 individuals produced were tall and dwarf individuals in the ration of 3:1.

Parents : Tall (TT) × Dwarf (tt)

Gametes : (T) (t)

F_1 generation : Tt (tall)

Selfing : Tt × Tt

Gametes : (T) (t) (T) (t)

F_2 generation :

	T	t
T	TT Tall	Tt Tall
t	Tt Tall	tt Dwarf

The phenotypic ration is 3 Tall : 1 Dwarf
The genotypic ration is 1 TT : 2 Tt : 1 tt
In this case, tallness is dominant over dwarfness, which is recessive not necessary for this expressed.

207. Define and design a test-cross.

Ans : **FOREIGN 2013**

1. A test cross is a devised by Mendel, where the offspring or an individual with a dominant phenotype, whose genotype is not known, is crossed with an individual homozygous for the recessive trait.
2. A monohybrid test cross is as follows:
3. The hybrid individual is crossed with a homozygous recessive individual.

Parents : Hybrid Tall (Tt) × Pure Dwarf (tt)

Gametes : (T) (t) (t)

Progeny :

	t
T	Tt Tall
t	tt Dwarf

The phenotypic anf genotypic ratios are the same.
1 Tall (Tt) : 1 Dwarf (tt)
If the dominant individual had been homozygous, all the individuals of F_1 would have been tall (hybrid tall).

Parents : Pure Tall (TT) × Pure Dwarf (tt)

Gametes : (T) (t)

Progeny : Tt (tall)

208. Using a Punnett Square, workout the distribution of phenotypic features in the first filial generation after a cross between a homoygous female and a heterzygous male for a single locus.

Ans : **COMP 2005**

The female may be homozygous recessive or homozygous dominant.

Cross I (Where the female is homozygous recessive)

Parents : Homozygous female bb × Heterozygous male Bb

Gametes : (b) (B) (b)

Progeny :

	b
B	Bb Dominant phenotype
b	bb Recessive phenotype

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219. Tallness is pea plant is a dominant trait, while dwarfnes is the alternate recessive trait. When a pureline tall is crossed with a pureline dwarf, what fraction of tall plants in F_2 shall be heterozygous? Give reasons.

Ans : **OD 2008**

Parents : Pure tall (TT) × Pure dwarf (tt)

Gametes : T, t

F_1 generation : Tt-Tall

Selfing : Tt × Tt

Gametes : T t, T t

F_2 generation :

	T	t
T	TT Tall	Tt Tall
t	Tt Tall	tt Dwarf

1. Phenotypic ratio : 3 tall : 1 Dwarf
   Genotypic ratio : 1 TT : 2 Tt : 1 tt
2. Two-thirds of the tall progeny is heterozygous.
3. It is because the gene for tallness (T) is dominant and express itself in the heterozygous condition, Tt.

220. In a typical monohybrid cross, the F_2 population ration is written as 3:1 for phenotype, but expressed as 1:2:1 for genotype. Explain with the help of an example.

Ans : **COMP 2012**

A monohybrid cross is as follows:

Parents : Smooth-seeded (SS) × Wrinkled-seeded (ss)

Gametes : S, s

F_1 generation : Ss (Smooth-seeded)

Selfing : Ss × Ss

Gametes : S s, S s

F_2 generation :

	S	s
S	SS Smooth-seeded	Ss Smooth-seeded
s	Ss Smooth-seeded	ss Wrinkled-seeded

1. The phenotypic ratio of smooth-seeded to wrinkled- seeded plants is 3:1.
2. From the Punnett square, it can be seen that one of the smooth-seeded plants is homozygous (SS), while the other two are heterozygous (Ss) and the wrinkled-seeded plant is homozygous recessive; hence, the genotypic ratio is 1:2:1.

221. A woman with blood group O married a man with blood group AB. Show the possible blood groups of the progeny. List the alleles involved in this inheritance.

Ans : **DELHI 2013**

Parents : Father AB group × Mother O group

Gametes : I^A I^B, i

Progeny : I^Ai (A group), I^Bi (B group)

The gene for blood group exists in three allelic forms I^A, I^B and i.

222. Differentiate between multiple allelism and pleiotropy with the help of an example of each.

Ans : **SQP 2018**

	Multiple allelism	Pleiotropy
1.	It is the phenomenon in which a gene for a trait exists in more than two allelic forms.	It is the phenomenon of the ability of a single gene to have more than one phenotypic effect.
2.	The alleles can show codominance. e.g. the gene for human blood groups exists in three allelic forms, I^A, I^B and i.	Codominance is not exhibited. e.g. a single gene in garden pea controls seed shape and size of starch grains.

223. Give an example of a gene responsible for multiple phenotypic expressions. What are such genes called? State the cause that is responsible for such an effect.

Ans : **FOREIGN 2015**

1. The gene controlling the shape of seed as well as the size of starch grains in garden pea plants shows multiple phenotypic expressions.
2. Such genes are called pleiotropic genes.

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196. Define polyploidy.

Ans : OD 2014

Polyploidy is condition in which a cell or organism possess more than two paired homologous sets of chromosome. It may occur due to abnormal cell division or can artificially be induced with the help of some chemicals. This phenomenon is more common in plants.

197. What do you understand by the following

1. Micro mutation
2. Macro mutation
3. Chromosomal mutation.

Ans : OD 2014

1. **Micro mutation :** They are also called as point mutation. These are the mutations in which a chemical change in DNA of cell occurs, that has no invisible impact on phenotype of organism. Such mutation alter the sequence of nucleotides in DNA molecule, that cause change in the information present on it, which results in difference in the proteins being produced. eg. Sickle cell anaemia.
2. **Macro mutation :** It is a mutation of large phenotype effect. It has ability to produce phenotype well outside the range of variations previously existing in the population. It is also called as frame shift mutation. It may be of three types insertions, inversions or deletions.
3. **Chromosomal mutation :** In it, loss or gain of segment of DNA, results in structural alteration in chromosomes. This cause abnormalities in organism. e.g. Down's syndrome, turner's syndrome etc.

198. What do you mean by emasculation? Why is it done ?

Ans : OD 2013

Emasculation is the process of removing anthers from bisexual flowers without affecting the female reproductive part (pistil), which is used in various plant hybridization techniques. Emasculation is performed by plant breeders in bisexual flowers to obtain the desired variety of a plant by crossing a particular plant with the desired pollen grain. To remove the anthers, the flowers are covered with a bag before they open. This ensures that the flowers is pollinated by pollen grains obtained from desirable varieties only. Later, the mature, viable, and stored pollen grains are dusted on the bagged stigma by breeders to allow artificial pollination to take place and obtain the desired plant variety.

199. What happens in haemophilia?

Or

Why is haemophilia called as bleeder's disease ?

Ans : OD 2012, SQP 2009

Haemophilia is bleeding disorder in which the blood does not clot normally. It is caused by mutations in the gene that makes clotting factors VIII or IX. These gene are located on the X chromosomes. People with haemophilia have little or no blood clotting factors, which are needed for normal blood clotting. There are two types of haemophilia:

1. Haemophilia A is also known as classic Haemophilia because it is the most common. Clotting factor VIII (eight) is low or missing in haemophilia A.
2. Haemophilia B may also be referred to as Christmas disease. Clotting factor IX (nine) is low or missing in haemophilia B.

The major signs and symptoms of haemophilia are excessive bleeding and easy bruising. A person with haemophilia does not bleed more quickly that other people, but he or she may bleed for a longer period of time before the body can form a clot. The extent of bleeding depends on how server the haemophilia is.

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200. Define linkage.

Ans : OD 2011

When genes for different characters are located in the same chromosome, they are tied to one another and are said to be linked. They are inherited together by the offspring and will not be assorted independently. Thus, the tendency of two or more genes of the same chromosome to remain together in the process of inheritance is called linkage. Linkage is of two types, complete and incomplete.

1. **Complete Linkage:** The genes located on the same chromosome do not separate and are inherited together over the generations due to the absence of crossing over. Complete linkage allows the combination of parental traits to be inherited as such.
2. **Incomplete Linkage:** Genes present in the same chromosome have a tendency to separate due to crossing over and hence produce recombinant progeny besides the parental type.

201. Write down the four stages involved in crossing over.

Ans : OD 2010

Crossing over is the exchange of genetic material between non-sister chromatids of homologous

Parents :	Male ZZ	×	Female ZW
Gametes :	(Z)		(Z) (W)
Progeny :	Z		W
Z	ZZ Male		ZW Female

229. Why does the son of a carrier mother and a normal father suffer from haemophilia, whereas the son of a haemophilic father and a normal mother would not? Explain.

Ans : **FOREIGN 2005**

1. The gene for haemophilia is present in the X-chromosome.
2. The son receives the X-chromosome from his mother; so, a carrier-mother passes on the disease to 50% of her sons.
3. When the mother is normal, the sons have no chance of getting the disease, even if the father is haemophiliac, because father passes on the Y-chromosome to his sons.

230. Differentiate between ZZ and XY type of sex-determination mechanism.

Ans : **FOREIGN 2009**

The difference between ZZ and XY type of sex-determination mechanism are as follows :

	ZZ mechanism	**XY mechanism**
1.	The females are ZW, i.e., heterogametic.	The females are XX, i.e., homogametic and males are XY, i.e. heterogametic.
2.	The sex of the offspring is determined by the type of ovum that is fertilized.	The sex of the offspring is determined by the type of sperm fertilizing the ovum.
3.	It is seen in birds.	It is seen in humans.

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231. How is Down's syndrome different from Klinefelter's syndrome/

Ans : **COMP 2006**

The difference between down's syndrome and Klinefalter's syndrome are as follows :

	Down's syndrome	**Klinefalter's syndrome**
1.	It is due to trisomy of 21st chromosome.	It is due to an extra X-chromosome in a male.
2.	It is an autosomal disorder.	It is a sex chromosomal disorder.
3.	The affected individual can be a male or a female.	The affected individual is a male, with more feminine characters.

232. Differentiate between Down's syndrome and Turner's syndrome.

Ans : **FOREIGN 2005**

The differentiate between Down's syndrome and Turner's syndrome are as follows :

	Down's Syndrome	**Turner's Syndrome**
1.	It is due to trisomy of 21st chromosome.	It is due to monosomy of X-chromosome.
2.	It is an autosomal disorder and the affected individual is a male or a female.	It is a sex chromosomal disorder and the affected individual is a female.
3.	The total number of chromosomes in the body is 47.	The total number of chromosomes in the body is 45.

233. A pea plant with purple flowers was crossed with a plant with white flowers, producing 50 plants with only purple flowers. On selfing, these plants produced 482 plants with purple flowers and 162 with white flowers. What genetic mechanism accounts for these results? Explain.

Ans : **OD 2021**

Since all the plants in the F_1 generation have purple flowers, purple flower colour is dominant.

1. These plants are heterozygous, produced from pure breeding/homozygous purple-flowered plants (PP) and homozygous white-flowered (pp) pea plants.

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248. Haemophilia and sickle-cell anaemia are blood related Mendelian disorders. Yet, they differ in their pattern of inheritance. Explain the difference.

Ans : FOREIGN 2009

	Haemophilia	Sickle-cell anaemia
1.	It is a sex-linked disorder, i.e., the gene of haemophilia is present on X-chromosome.	It is an autosomal disorder.
2.	More males, than females, are affected because a male has only one X-chromosome while a female has two X-chromosome and has to be homozygous recessive for the disease.	It affects both males and females equally.
3.	A carrier female transmits the disease to some of her male offspring	When both the parents are carriers, the disease is transmitted to the offspring.

249. How is aneuploidy different from polyploidy? Mention their causes.

Ans : DELHI 2005

The difference between aneuploidy and polyploidy are as follows :

	Aneuploidy	Polyploidy
1.	It is the phenomenon of loss of gain of one or more chromosomes from any pairs(s) of chromosomes in a diploid cell/ organism, called aneuploid.	It is the presence of three or more sets or chromosomes in an organisms, called polyploid.
2.	It arises due to failure of segregation of members of one/ more pairs(s) of homologous chromosomes. e.g. Down's syndrome, Turner's syndrome, etc.	It arises due to failure of cytokineses following the telophase stage of cell division.
		It is found in many plants.

250. About 8% of human male population suffers from colourblindness whereas only about 0.4% of human female population suffers from this disease. Write an explanation to show how it is possible.

Ans : FOREIGN 2009

Colourblindness is a X-linked recessive disorder which shows transmission from carries female to male progent. In females colour blindness appears only when both the sex chromosomes carry the recessive gene (X^cX^c). The females have normal vision but function as carrier if a single recessive gene for colourblindness is present (XX^c). However, in human males the defect appears in the presence of a single recessive gene (X^cY) because Y-chromosome of male does not carry any gene for colour vision. As a result colour blindness is more common in males (8 %) as compared to females (0.4 %).

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251. Differentiate between monosomy and trisomy. Give an example of each from human genetics.

Ans : SQP 2005

The differentiate between monosomy and trisomy are as follows :

	Monosomy	Trisomy
1.	It is the condition where a diploid individual lacks one member of any one pair of chromosomes.	It is the condition where a diploid individual has an additional copy of a chromosome.
2.	The individual has (2n - 1)number of chromosomes. e.g. Turner's syndrome, i.e. monosomy of X-chromosome.	The individual has (2n +1) number of chromosomes. e.g. Down's syndrome, i.e. trisomy of 21^{st} chromosome.

252. Why are colourblindness and thalassemia categorised as Mendelian disorders? Write the symptoms of these diseases seen in people suffering from them.

Ans : OD 2006

Colourblindness and thalassemia are categorised as Mendelian disorders because of the following reasons:

(a) They are mainly due to alteration or mutation in a single gene.

(b) These disorders are transmitted to the offspring in the same line as Mendelian principles of inheritance, i.e., by the parents who are carriers and are apparently normal.

Red-		Pink-		White-
flowered	:	flowered	:	flowered
RR	:	Rr	:	rr
1		2		1

236. Mendel published his work on inheritance of characters in 1865, but it remained unrecognised till 1900. Give three reasons for the delay in accepting his work.

Ans : **SQP 2012**

Mendel's work remained unrecognised for the following reasons:

1. His work could not be widely publicised a s communication was not easy.
2. His concept of factors as stable and discrete units that controlled the expression of traits and that the pair of alleles which did not blend with each other, were not accepted by his contemporaries as the explanation of variation.
3. Mendel's approach of using mathematical logic to explain the biological phenomena was new and unacceptable to many biologists.
4. Though Mendel's work suggested that factors were discrete units, he could not provide any physical proof for the existence of factors or prove what they are made of.

237. In pea plants, the colour of the flower is either violet or white, whereas human skin colour shows many gradations. Explaing giving reasons, how it is possible.

Ans : **OD 2005**

In pea plants-

1. The flower colour is controlled by a single gene and it exists in two allelic forms, V and v.
2. The allele for violet colour 5 is dominant over the allele for white colour 5.
3. The dominant allele expresses itself in the homozygous (TT) as well in the heterozygous (Tt) conditions hence, the flowers are violet.
4. In the absence of a dominant allele, the recessive alleles in the homozygous condition, express the white colour.

In humans-

1. The skin colour is controlled by three genes (located in different loci), A, B and C, each having two allele.
2. The phenotype is the expression of the cumulative or additive effect of all the dominant alleles, a person has.
3. A person with all six dominant alleles (AABBCC) has the darkest skin while, the genotype aabbcc produces the fairest/lightest skin and the genotype AaBbCc produces the intermediate colour.
4. Thus, there is gradation in the skin colour, which depends on the number of dominant alleles in the genome.

238. Morgan carried out several dihybrid crosses in Drosophila and found F_2 ratios deviated very significantly from the expected Mendelian ratio. Explain his findings with the help of an example.

Or

During his studies on genes in Drosophila that were sex-linked, T.H. Morgan found F_2 population phenotypic ratios deviated from the expected 9 : 3 : 3 : 1. Explain the conclusion, he arrived at.

Ans : **FOREIGN 2006**

Morgan's conclusion

1. The genes were located on the X-chromosome.
2. They found that when the two genes in a dihybrid cross were situated on the same chromosome, the proportion of parental gene combinations were much higher than the non-parental gene combinations, called recombinants.
3. Morgan attributed this to linkage, i.e. physical association between the genes on a chromosome.
4. He also found that some genes were tightly linked and showed very low recombination, while some genes were loosely linked and showed higher recombination frequency.

239. A red-eyed heterozygous female fruit-fly, Drosophila melanogaster is crossed with a white-eyed male. Work out the possible genotypes and phenotypes of the progeny. Comment on the pattern of inheritance of eye colour in fruit-fly.

Ans : **COMP 2008**

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Parents : Red-eyed Female $X^{W+}X^{W}$ × Red-eyed Male $X^{W}Y$

Gametes : (X^{W+}) (X^{W}) (X^{W+}) (Y)

Progeny :

	X^{W+}	Y
X^{W+}	$X^{W+}X^{W+}$ Red-eyed Female	$X^{W+}Y$ Red-eyed Male
X^{W}	$X^{W+}X^{W}$ Red-eyed Female	$X^{W}Y$ White-eyed Male

Parents : Purple-flowered × White-flowered

PP pp

Gametes : (P) (p)

F_1 generation : Pp (Purple-flowered)

Selfing of F_1 Generation : Purple-flowered × Purple-flowered

Pp Pp

Gametes : (P) (p) (P) (p)

F_2 generation :

	P	p
P	PP Purple-flowered	Pp Purple-flowered
p	Pp Purple-flowered	pp White-flowered

Purple-flowered : White-flowered are in the ratio of 3(482) : 1(162).

2. It is due to segregation of the factors that remained together in the hybrid.
3. The factors segregate from each other during gamete formation and a gamete receives only one of the two factors; a homozygous parent produce all gametes that are similar, while a heterozygous parent produces two kinds of gametes, each having one allele in equal proportions.

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234. How would you find genotype of a tall pea plant bearing white flowers? Explain with the help of a cross. Name the type of cross you would use.

Ans : **FOREIGN 2005**

The given plant must be crossed with a dwarf plant bearing white flowers.

1. If the tall plant is homozygous, all the plants in the progeny will be tall (cross 1).
2. If the tall plant is heterozygous, tall plants and dwarf plants will be in equal proportion in the progeny.

Cross 1 : Homozygous tall plant with white flowers.

Parents : Tall, white × Dwarf, white

TTvv ttvv

Gametes : (Tv) (tv)

Progeny : Ttvv (Tall, white)

Cross 2 : Heterozygous tall plant bearing white flowers.

Parents : Tall, white × Dwarf, white

TTvv ttvv

Gametes : (Tv) (tv) (tv)

Progeny :

	Tv	tv
tv	Ttvv Tall white	ttvv Dwarf white

235. Work out a cross between true-breeding red and white-flowered dog-flower plants (snapdragon) upto F_2 progeny. Explain the results of F_1 and F_2 generations.

Ans : **DELHI 2009**

Parents : Red-flowered (RR) × White-flowered (rr)

Gametes : (R) (r)

F_1 generation : Rr (Pink-flowered)

Self-pollination : Rr × Rr

Gametes : (R) (r) (R) (r)

F_2 generation :

	R	r
R	RR Red-flowered	Rr Pink-flowered
r	Rr Pink-flowered	rr White-flowered

1. The F_1 individuals are pink-flowered which is a case of incomplete dominance. It is a phenomenon in which neither of the two alleles of a gene is completely dominant over the other and the F_1 hybrid is an intermediate between the two parents.
2. The alleles of the hybrid segregate during gamete formation and the parental characters reappear without any change in F_2 generation; hence, the phenotypic and genotypic ratios of the F_2 are the same i.e.,

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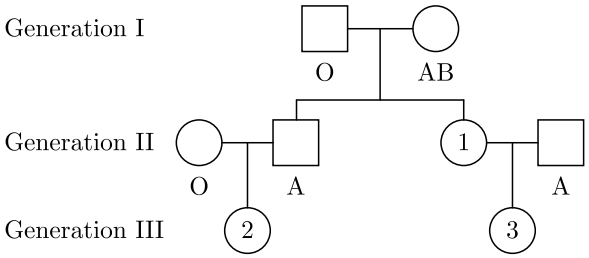
3. When the ovum is fertilised by a male gamete, the zygote (2n = 32) develops into a female, i.e. a queen or worker.
4. When the ovum develops by parthenogenesis, i.e. without fertilisation, a male individual, called drone is formed.
5. The male honeybee (drone) is haploid (with n = 16) and forms sperms by mitosis.

244. Study the following pedigree chart of a family, starting with mother with AB blood group and father with O blood group.



1. Mention the blood group as well as the genotype of the offspring numbered 1 in generation II.
2. Write the possible blood groups as well as their genotypes of the offspring numbered 2 and 3 in generation III.

Ans : **OD 2015**

1. Offspring 1 may have blood group A (I^Ai) or blood group B (I^Bi).
2. Offspring 2 may have blood group A (I^Ai) or blood group O.
3. Offspring 3 may have :

(a) If offspring 1 is blood group A.
- (i) blood group A (may be I^AI^A or I^Ai)
- (ii) blood group O., if father is heterozygous for A

(b) If offspring 1 is of blood group B
- (i) blood group AB (I^AI^B)
- (ii) blood group A (I^Ai)
- (iii) blood group B (I^Bi), if father is heterozygous for A.
- (iv) blood group O., if father is heterozygous for A.

245. 1. Sickle-celled anaemia in humans is a result of point mutation. Explain.

2. Write the genotypes of both the parents who have produced a sickle-celled anaemic offspring.

Ans : **SQP 2019**

1. Mutation arising due to a change in a single base pair of DNA, is called point mutation.
   (a) The defect is caused by the single base substitution at the sixth codon of the beta chain of gaemoglobin from GAG to GUG; this leads to substitution of glutamic acid by valine.
   (b) The mutant of defective haemoglobin molecule undergoes polymerisation under low oxygen tension causing sickle-shaped RBCs.
2. The parent must be Hb^AHb^S and Hb^AHb^S.

246. What is the cause of phenylketonuria? Explain the disorder.

Ans : **COMP 2022**

1. It is caused by a recessive mutant allele on chromosome 12.
2. The affected individuals lack an enzyme that catalyses the conversion of the amino acid phenylalanine into tyrosine.
3. As a result, phenylalanine is metabolised into phenyl pyruvate,phenyl acetate, etc.
4. Accumulation of these chemicals in the brain results in mental retardation.
5. Accumulation of these chemicals in the brain results in mental retardation.
6. These are also excreted in the urine, as they are not absorbed by the kidney tubules.

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247. Give an example of an autosomal recessive trait in humans. Explain its pattern of inheritance with the help of a cross.

Ans : **DELHI 2023**

1. Sickle-cell anaemia, phenylketonuria and thalassemia are autosomal recessive trait in humans.
2. The disease is transmitted to the offspring, when both the parents are carries of the disease, i.e., they are heterozygous.
3. In sickle-cell anaemia, the heterozygous (Hb^AHb^S) individuals are apparently normal.
4. The cross is as follows :

Parents : Carrier male Hb^AHb^S × Carrier female Hb^AHb^S

Gametes : (Hb^A) (Hb^S) (Hb^A) (Hb^S)

Progeny :	Hb^A	Hb^S
Hb^A	Hb^AHb^A Normal	Hb^AHb^S Carrier
Hb^S	Hb^AHb^S Carrier	Hb^SHb^S sufferer

5. 25% of theprogeny can be sufferers.

the other from the father. The chromosomes retain their **uniqueness** and **individuality** as well as continuity. Each chromosomes has Mendelian factors or hereditary determiners. The behaviour of chromosomes during meiosis gives an evidence that genes lie on the chromosomes. It explains segregation and independent assortment.

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259. Distinguish between Alpha, Beta and Delta Thalassemia.

Ans : **SQP 2005**

Differences Between Alpha (α), Beta (β) and Delta (δ) Thalassaemia are as follows :

	Alpha (α) Thalassaemia	**Beta (β) Thalassaemia**	**Delta (δ) Thalassaemia**
(i)	This includes the genes HBA1 Menelian way; Two gene loci and thus 4 alleles, and connected to deletion of the 16p chromosome.	It occurs due to the mutations in gene HBB on chromosome -11. It is inherited autosomal recessive way. Mutation exhibits the severity of disorders	In this type mutation can take place that influences ability of gene to produce delta (δ) chanis.
(ii)	This results in reduction of α-globin production; a few α-globin chains produced; this causes an excess of β chains of globin in the adults but excess of gamma (γ) chains in newborn.	β° or even β Thalasaemia major is produced by mutation (prevent formation of β-chains in adults): Severe form of this disease in humans. It is β^{+} or β Thalassaemia intermedia (some formation of β-chains take place) in it.	The alpha (α) and Beta (β) chains occur in Hb (haemoglobin); app 3% of adult consists of α-and β -chains.
(iii)	HbH of four β-chains or the hemoglobin H (unstable tetramer) occurs by excess of β -chains; it is characterised by abnormal O_2 Dissociation cuves.	There remains excess of α -chains; they don't make tetramers : Moreover these bind to RBC's membrances and destroy membranes. They can form toxic aggregates when present in high concentrations.	There may be three percent of alpha and Beta chains in haemoglobin.

260. How do pleiotropy, incomplete dominance, co-dominance and polygenic inheritance deviate from the observation made by Mendel? Explain with the help of one example for each.

Ans : **FOREIGN 2009**

According to law of dominance when two individuals of a species, differing in a pair of contrasting forms of a trait are crossed, the form of the trait that appears in the F_1 hybrid is dominant and the alternate form tat remains hidden is called recessive.

Incomplete dominance and co-dominance are exception to this law.

Incomplete dominance is the phenomenon where none of the two contrasting alleles or factors is dominant. **The expression of the character in a hybrid of F_1 individual is intermediate or a fine mixture of the expression of the two factors**. As seen in Mirabilis jalapa where when two types of plants having flower colour in pure state red and white are crossed, the hybrid of F_1 generation have pink flowers.

Co-dominance is the phenomenon of expression of both the alleles in a heterozygote, i.e., **both alleles are able to express themselves independently when present together**. E.g. hair colour in cattle, the hybrid of F_1 generation are of roan colour i.e., having a dark coat interspered with white hair.

According to Mendel one gene control the expression of one character only. Pleiotropy is exception to this. The ability of a gene to have multiple phenotypic effect because it influences a number of characters simultaneously is known as pleiotropy.

The gene having a multiple phenotypic effect bacause of its ability to control expression of two

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(c) The pattern of inheritance of these disorders can be traced in a family by pedigree analysis.
Symptoms of Colourblindness : The person fails to discriminate between red and green colour due to the defect in either red or green cone cells of retina.
Symptoms of Thalassemia : The person suffers from anaemia as the synthesis of either alpha globin chain(s) or beta globin chain(s) of haemoglobin is impaired.

253. How does a chromosomal disorder differ from a Mendelian disorder?

Ans : **COMP 2012**

Differences between Mendelian and chromosomal disorders are as follows :

	Mendelian disorder	**Chromosomal disorder**
(i)	This disorder is mainly due to alternation or mutation in the single gene.	This disorder is caused due to absence or excess or abnormal arrangement of one or more chromosomes.
(ii)	This follows Mendel's principles of inheritance.	This does not follow Menel's principles of inheritance.
(iii)	This may be recessive or dominant in nature.	This is always dominant in nature.
(iv)	For example, haemo-philia, sickle-cell anaemia.	For example, Turner's syndrome.

LONG ANSWER QUESTIONS

254. What do you mean by chromosomal disorder? Describe the cause and related abnormalities in the following genetic disorders:

1. Down's syndrome
2. Klinefelter's syndrome
3. Turner's Syndrome.

Ans : **FOREIGN 2005**

Chromosomal disorder are the genetic disorder caused due to the absence or excess or abnormal arrangement of one or more chromosomes. Such disorders do not get inherited like medalian traits. On the basis of type of chromosome in which the defect occur, the chromosomal disorder can be of two types.

1. **Autosomal disorders-** These genetic disorder arise due to abnormalities in autosomal chromosome number e.g. Down's syndrome, Patau's syndrome, Edward's syndrome and Cri-Du-chat syndrosme.
2. **Sex-chromosomal disorders-** These are the genetic disorders which arise due to abnormalities in sex chromosome number. eg. Turner's syndrome, Klinefelter's syndrome, super males and super females.
   (a) **Down's Syndrome (Mongolism)-** It is an autosomal disorder, caused by trisomy of chromosome 21 due to non disjunction of homologous chromosome during meiotic division. Such individuals are mentally retarded, short height with round head, open mouth with protuding tongue, slanding eyes, under developed genitals etc.
   (b) **Klinefelter's syndrome-** It is caused due to the presence of extra copy of X -chromosome in an individual $(45 + XXY)$ .such persons are sterile males with undeveloped testes, mental retardation, sparse body hair with female features like, well developed breasts, thus showing gynacomastia.
   (c) **Turner's syndrome-** It is caused due absence of one of the X-chromosome. Such individuals have karyotype $45 + XO$. The affected individuals are sterile females with rudimentary ovaries, have shield shaped chest with poorly developed breasts and webbed neck.

255. Define crossing over. Describe the process with the help of diagrams.

Ans : **OD 2017, OD 2016**

Crossing over is the exchange of genetic material between non-sister chromatids of homologous chromosomes during meiosis (Prophase I, diplotene stage), which results in new allelic combinations in the daughter cells.

Mechanism of crossing over : The process of crossing over can be mainly divided into following stages.

1. **Synapsis :** In prophase-I of meiosis homologous chromosomes pair lengthwise. The pairing starts at one or more points and proceeds along the whole length in a zipper fashion. The process of pairing is called synapsis. The paired homologous chromosomes are called

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Pattern of Inheritance :

1. The gene for eye-colour in fruit fly (Drosophila) is located on X-chromosome, i.e. sex-linked.
2. Red eye colour is dominant over white eye colour.
3. A female fruit fly has two X-chromosomes and can be heterozygous for red eye colour.
4. A male has only one X-chromosome and hence is pure for eye colour trait there is no corresponding allele on the Y-chromosome.
5. The male receives the X-chromosome from the female parent and Y-chromosome from the male parent.
6. A female receives the X-chromosomes from the father and another from the female parent.

240. Why are grasshopper and Drosophila said to show male heterogamety? Explain.

Ans : **DELHI 2005**

Male heterogamety

(a) A male grasshoper produces two types of gametes with reference to sex chromosomes, i.e. 50% of them with one X-chromosome and 50% of them with no X-chromosome.

(b) A male Drosophila produces 50% of gametes with one X-chromosome and 50% of them with one Y-chromosome.

(c) Since they produce two types of gametes with reference to sex chromosomes, they are said to show male heterogamety.

241. Explain female heterogamety with the help of an example.

Ans : **SQP 2010**

Female heterogamety

(a) It is the phenomenon in which femlaes of a species produce two types of gametes with reference to sex-chromosomes.

(b) A male Drosophila produces 50% of gametes with one X-chromosome and 50% of ova with one Z-chromosome.

(c) The sex of the offspring is determined by the type of ovum fertilised.

242. Explain the mechanism of sex-determination in insects like Drosophila and grasshopper.

Ans : **COMP 2015**

1. **Sex determination in Drosophila :**

(a) In Drosophila, sex determination is of XY type and both males and females have the same number of chromosomes, i.e. 4 pairs.

(b) The males have three pairs of autosomes and XY-chromosomes.

(c) The females have three pairs of autosomes and XX-chromosomes.

(d) The males are heterogametic and produce two types of sperms, 50% of them carrying one X-chromosome and the other 50% with one Y-chromosome.

(e) The females are homogametic and all ova contain one X-chromosome.

(f) The sex of the insect is determined by the type of sperm fertilising the ovum; the ovum fertilised by the X-carrying sperm develops into a female, while that fertilised by the Y-carrying sperm develops into a male.

2. **Sex determination in Grasshopper** :

(a) Sex determination in grasshopper is of XO type.

(b) The males have one X-chromosomes other than the autosomes.

(c) The females have two X-chromosomes (XX) other than the autosomes.

(d) Males produce two types of sperms, 50% of them with one X-chromosome and 50% of them with no X-chromosome.

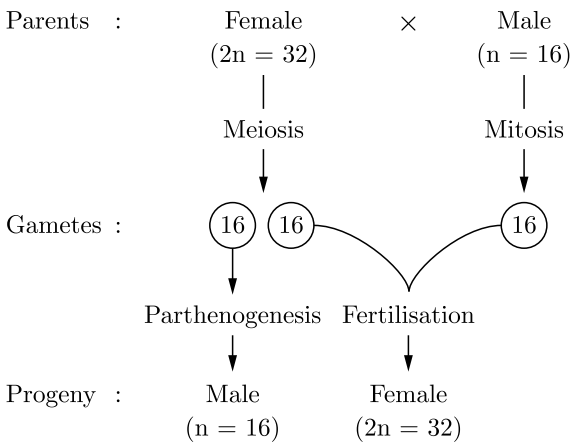
(e) Ova fertilised by a sperm carrying X-chromosomes develop into females, while those fertilised by a sperm, carrying no X-chromosome develop into males.

243. Explain the mechanism of sex-determination in honeybees.

Ans : **FOREIGN 2013**

Sex-determination in honeybees :

1. The sex determination is as follows:
2. Haplodiploid sex-determination is seen in honeybees; it is based on the number of sets of chromosomes, an individual receives.



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(c) **Multiple alleles :** In it, more than two alternative forms (allele) of a gene occupying the same locus on a chromosome in a population. The ABO blood grouping is a good example of multiple alleles.

2. **Intergenic or non-allelic gene interaction :** The gene interaction in which the gene present in one gene locus interacts with the another gene present in another gene locus of the same Or different chromosomes for the expression of phenotypic character is called intergenic or non-allelic gene interaction.
   (a) **Complementary gene** (9 : 7) **:** Two non-allelic genes together produce an effect by complementing each others action. e.g. flower colour in Latnyrus odoratus.
   (b) **Supplementary gene** 9 : 3 : 4 **:** Two non-allelic genes in which dominant gene produce its effect irrespective of the presence or absence of other. e.g. coat colour of mouse.
   (c) **Dominant epistasis** (12 : 3 : 1) **:** One gene suppresses non-allelic gene irrespective of its dominant or recessive state. e.g. inheritance of coat colour indogs.
   (d) **Recessive epistasis** 9 : 3 : 4 **:** When a gene suppresses non-allelic gene when in homozygous recessive state.
   (e) **Duplicate gene or Pseudo alleles** (15 : 1) **:** Two pairs of gene which determine same phenotype hence, either of them is able to produce the character. e.g. fruit shape in shepherd's purse.
   (f) **Collaborator gene :** Two gene pairs which are present on the separate locus but interact to produce some totally new trait or phenotype that neither of the genes alone could produce for example, inheritance of combs in poultry.
   (g) **Pleiotropic genes :** In it, one gene infhences two or more seemingly unrelated phenotypic traits. e.g. phenylketonuria disease.

257. Describe multiple allelism showing the inheritance pattern of blood groups in human beings.

Ans : **OD 2013**

The multiple alleles can be defined as a set of 3 or 4 or more allelomorphic genes or alleles, which have arisen as a result of mutation of the normal gene and which occupy the same locus in the homologous chromosomes.

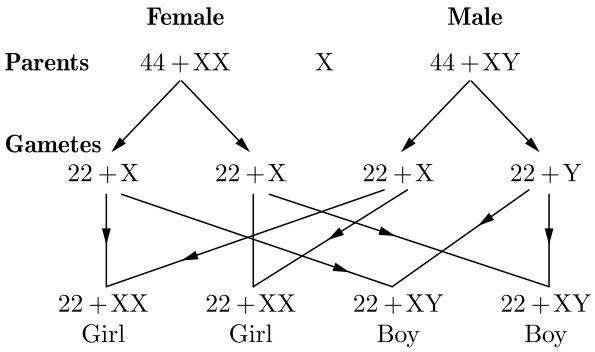
These multiple alleles express two or more forms of a single gene.

Human blood group system ABO is best example of multiple allelism, which mainly has three alleles. All these alleles occupy same locus of homologous chromosomes.

Blood groups were discovered by **Karl Landsteiner.** There are four types A, B AB and O of blood groups present in human.

ABO blood groups are controlled by gene I, which has three alleles I^A, I^B and i.

Alleles I^A and I^B are completely dominant over i. Therefore, when I^B and i. are present, only I^B expresses itself; similarly, the I^A expresses itself when I^A and i are present. Gene I^A produces antigen-A and I^B produces antigen-B. Gene I^A and I^B are codominant. So, a heterozygote person (having genotype I^A I^B) has both antigen-A and antigen-B and that is why, his/her blood group is AB.



Since, there are three different alleles, a total of six different genotypes of blood groups are found in nature. So, there can be A, B and AB blood groups in the offsprings.

258. Explain Chromosome Theory of inheritance.

Ans : **DELHI 2005**

Sutton (1900) explained the parallelism between segregation of chromosomes during meiosis and **transmission of factors or genes** at the time of gametogenesis. It was based on the following points:

1. Both occur in **pairs** in dipoid cells (2N).
2. The homologous chromosomes **separate** and the gene pairs segregate during the meiosis cell division.
3. The gametes possess only set of genes and the chromosomes.
4. During the process of **fertilization**, the paired condition of genes and the chromosomes is restored

Sutton and Boveri (1902) suggested chromosome theory of Inheritance. Somatic cells of an individual (developed from zygote) are **diploid** (2N). One set of chromosomes from mother and

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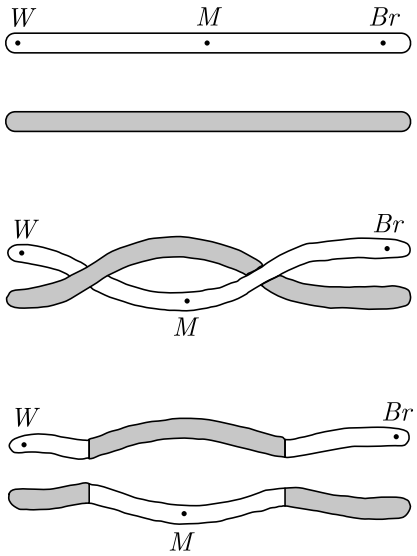
bivalents. The two homologous chromosomes are held together by a synaptonemal complex.

2. **Duplication of chromosomes :** Synapsis is followed by the duplication of chromosomes which changes the bivalent nature of chromosome to four stranded tetravalent stage. It occurs due to splitting of homologous chromosomes into sister chromatids attached with un-splitted centromeres.
3. **Crossing-over :** In pachytene stage crossing over takes place. Non-sister chromatids of homologous pair twist over each other due to action of enzyme endonuclease. The chromatids get connected with each other at points known as chiasmata. The crossing over take place at several points. The number of chiasmata formed is proportional to the length of chromatids. The genes at distant loci undergo crossing-over but closely placed genes fail to cross-over and exhibit the phenomenon of linkage.
4. **Terminalisation :** During diakinesis of prophase-I chiasmata move towards the end of bivalent by a process called terminalization. Thus twisting chromatids separate so that the homologous chromosomes are separated completely.



256. Define Interaction of Genes with suitable crossing and examples.

Ans : **OD 2017**

Gene interaction is the influence of allelic or non-allelic genes on normal phenotypic expression of the trait. These are the deviations of mendel's laws of Inheritance. It is of two types.

1. **Intragenic or Interallelic gene interaction :** The gene interaction in which two alleles present on the same gene locus on the two homologous the chromosome of a gene interact together for phenotypic expression is called interallelic gene interaction. This allelic gene interaction modifies the Mendelian monohybrid, phenotypic F_2 ratio 3 : 1 to 1 : 2 : 1. The examples of this interaction are as follows.
   (a) **Incomplete Dominance :** In this, dominant allele does not completely express itself. e.g. pink flower in Mirabilis jalapa or 4'O clock plant.

P-Generation AA (Red flower) × aa (White flower)

Gametes (A) (A) (a) (a)

F_1 Generation Aa (Pink flower)

Second cross Aa × Aa

F_2 Generation

(Female gametes) \ (Male gametes)	A	a
A	AA Red	Aa Pink
a	aA Pink	aa White

1 : 2 : 1

(b) **Co-dominance :** Here, both the alleles lack dominant recessive relationship and express themselves together, e.g. roan coat colour in cattle, M-N blood group in humans etc.

P-Generation Ww (White) × ww (Red)

Gametes (W) (w)

F_1 Generation Ww (Roan)

Second cross Ww × ww

F_2 Generation

(Female gametes) \ (Male gametes)	W	w
W	WW White	Ww Roan
w	wW Roan	ww Red

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or more characters is called pleiotropic gene. For example, in cotton a gene for the lint also influence the height of plant, size of the boll, number of ovules and viability of seeds.

Polygenic inheritance is a type of inheritance controlled by one or more genes in which the dominant alleles have cumulative effect with each **dominant allele expressing a part or unit of the trait, the full trait being shown only when all the dominant alleles are present**. The genes involved in quantitative inheritance are called polygenes and inheritance called as polygenic inheritance. E.g., human skin colour. Human skin colour is caused by pigment called melanin. The quantity of melanin is due to three pairs of polygenes (A, B and C). If black or very dark (AABBCC) and white or very light (aabbcc) individuals marry, the offspring show intermediate colour called mulatto (AaBbCc). When two such individuals of intermediate colour marry, the skin colour of the children will vary from very dark or black to very light or white. A total of eight allele combinations is possible in the gametes forming 27 distinct genotypes distributed into 7 phenotypes.

261. 1. Write the scientific name of the organism Thomas Hunt Morgan and his colleagues worked with for their experiments. Explain the correlation between linkage and recombination with respect to genes as studied by them.

2. How did Sturtevant explain gene mapping while working with Morgan?

Ans : **COMP 2010**

1. The organism that was used by Thomas Hunt Morgan and his colleagus for their experiments on linkage was Drosophila melanogaster. They found that the genes located on same chromosome remain linked together in passing from one generationto to other due to phenomenon of linkage. Linked genes tend to transmit together in a single unit. The mendelian dihybrid ratio of 9 : 3 : 3 : 1 is modified as the two genes fail to assort independently due to linkage Morgan carried out several dihybrid crosses in Drosophila to study genes that were sex linked. He hybridised yellow-bodied, white eyed females to brown bodied, red-eyed males and intercrossed their F_1 progeny. The F_2 generation deviated significantly from the Mendelian ratio.

Morgan and his colleagues knew that the genes were located on the X chromosome and deduced that when two genes in a dihybrid cross were situated on the same chromosome, the proportion of parental gene combination to describe the generation of non-parental type due to linkage. They coined the term recombinations were much higher than the non-parental gene combinations. They also discovered that even when genes were grouped on the same chromosome, some genes were very tightly linked and showed very low recombination. They found that the genes recombination while white and miniature wing showed 37.2 % recombination.

2. Sturtevant used the frequency of recombination between the gene pairs on the same chromosome as a measure of the distance between genes and mapped their position on the chromosome. This resulted in a chromosome map which was a linear graphic representation of sequence and relative distances of the various genes present in that chromosome. This relative distance between genes was indicated by the percentage of their recombination or crossing over. A 100% cross over was termed as Morgan (M), 10 % as deciMorgan (dM) and 1% as centiMorgan (cM) or 1 map unit. Today genetic maps are extensively used asa starting point in the sequencing of whole genomes.

262. Both haemophilia and thalassemia are blood related disorders in humans. Write their causes and the difference between the two. Name the category or genetic disorder they both come under.

Ans : **OD 2009**

Haemophilia is genetically due to the presence of a recessive sex linked gene h, carried by X-chromosome. Thalassemia is caused due to mutation or deletion of gene controlling formation of globin chains of haemoglobin.

Haemophilia is a sex-linked recessive disorder and thalassemia is an autosomal linked recessive disease.

Both haemophilia and thalassemia are mendelian disorders.

Differences between haemophilia dna thalassemia are as follows:

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8. REGULATION OF GENE EXPRESSION

The genes control the **metabolism.** The genes restore and express genetic information.

9. BEADLE AND TATUM

It is proposed **one gene one enzyme hypotheses** after working with a fungus Neurospora crassa.

10. GENE AND PROTEINS

Enzymes are proteinaceous but all proteins need not to be enzymes. Proteins are complex molecules and may be composed of one or more **polypeptide chain**. Thus one gene one enzyme hypthesis changes to **one gene one polypeptide hypothesis**.

11. CENTRAL DOGMA OF MOLECULAR BIOLOGY

The unidirectional flow of information from DNA → RNA → protein is called the central dogma in molecular biology. It was explained by F.H.C. Crick (1958).

There are a group of viruse called retroviruses which have RNA as the genetic material. These viruses carry the gene for reverse transcription and the enzyme reverse transcriptase catalyses the conversion of RNA of DNA. It was belived that the flow of information was unidirectinoal

DNA → RNA → Protein

But with the discovery of enzyme reverse transcriptase it is established that RNA can also go back to DNA.

DNA ← RNA → Protein

But this is the characteristics of retrovirus only and other viruses do not follow this mechanism.

12. TRANSCRIPTION

It is governed by the **principle of complementarity** but it does not mean identical. **Transcription** is "the process by which DNA gives rise to mRNA".

13. TRANSLATION-BIOSYNTHESIS OF PROTEINS

Translocation is "the proces in which the tRNA at the 'A site' is pulled to the 'P site' along with mRNA." Protein synthesis takes place on ribosomes and rRNA makes the ribosomes. tRNA is much smaller than mRNA. The bond between two amino acids is called peptide bond. Peptidyl transferase is the enzyme which catalyses the formation of peptide bond between the first amino acid (Methionine) and the second amino acid. 'P' site is the site on mRNA where the initiator codon (Ist codon) lies. The 'A site' is the site of mRNA close to the 'P' site where second amino acyl tRNA enters the ribosome.

14. ANTICODON

Present on RNA which compliment with the mRNA codons are called anticodon. It is the second site of tRNA. If AUG is codon then UAC will be anticodon.

15. TYPES OF RNA

m-RNA, r-RNA and t-RNA are three types of RNA. t-RNA is smallest among these three and mostly identical in prokaryotes and eukaryotes. R.W. Holley (1965) suggested cloverleaf model of tRNA and looks like L-shaped structure.

16. GENETIC CODE

Genetic code is "the complex arrangement of genes by which the information in RNA is decided into a polypeptide."

A triplet of bases present on mRNA and which codes for one amino acid is called codon. A triplet of bases present on tRNA and which compliments with mRNA codons is called anticodon. Codons AUG (Methionine) and GUG **(Valine)** are the **start signals**. Codons **UAA (Ochre), UAG (Amber) and UGA (Opal)** are **stop Signal** or **terminating codons** or **none-sense codons.**

17. MOLECULAR MECHANISM OF MUTATION AND GENETIC CODE

Insertion of an addition gene causes mutation. Deletion may also cause mutation.

Frameshift Mutation : Shifting of entire reading frame due to loss or addition of a single base or a segment of DNA causes frameshift mutation.

These are called **deletion mutations**. **Wobble position** is the position on the codon, when the mutation takes place in the 3rd base of the triplet codon, which still permits interaction with the anticodon on the corresponding tRNA. **Mutation** which do not cause any change in the protein are known as **silent mutations. Sickle cell anaemia is** due to a single base change in B chain of **haemoglobin.** (It result in a change from glutamic acid to valine at position 6 in the B chain). **Thalassemia** is also **haemoglobin based genetic disorder** (one type of thalassemia involves frameshift mutation in haemoglobin B chain).

Point mutation is a change in single base pair of a gene e.g. Sickle cell anaemia

18. LAC-OPERON : REGULARION OF GENE EXPRESSION

The action of enzyms is regulated by certain genes such as regulator gene, promoter gene and operator gene.

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(iv) Name a best known and most common autosomal aneuploid abnormality in human and write any two symptoms.

Ans : SQP 2023

(i) Gain or loss of chromosome due to failure of segregation of chromatids during cell division cycle is known as aneuploidy.

(ii) 22 + XY, 22 + 0

(iii) Klinefelter's syndrome
Gynaecomastia/ feminine development, sterile individual, tall stature, overall masculine development
(Any two)

(iv) Down's Syndrome:
Short statured with small round head, furrowed tongue, partially open mouth , broad palm with palm crease , physical/ psychomotor/mental retardation , flat back of head , loops on finger tips , congenital heart disease , big and wrinkled tongue , broad flat face
(Any two)

265. In a plant species that follows Mendelian inheritance yellow flower colour is dominant over white and round fruit shape is dominant over elongated. Crossing was performed between two purelines-one having yellow-flower and round fruit and another with white flower and elongated fruits. About 20 plants survived in F_1 progeny. Plants of F_1 were allowed to self fertilise and about 960 plants survived in F_2.

(i) How many plants would have yellow flower and round fruit in F_1 generation?

(ii) How many plants would have yellow flower and round fruit in F_2 generation?

(iii) Mention the genotypic and phenotypic ratio when plant heterozygous for yellow flower and round fruit is crossed with the double recessive parent.

(iv) If the plant heterozygous for yellow flower and round fruit are self crossed, then what will be the genotype of plant with yellow flower and elongated fruit?

Ans :

(i) In F_1 generation, all the 20 plants would be heterozygous for the trait and thus, they would possess yellow flower and round fruit.

(ii) When heterozygous plants in F_1 generation undergo selfing, F_2 progeny gives 9:3:3:1 phenotypic ratio. Thus, in the given case, yellow flower with round fruit are $960 \times \frac{9}{16} = 540$

(iii) When heterozygous for yellow flower and round fruit is crossed with double recessive parent then genotypic and phenotypic ratio will be 1:1:1:1.

Parents : YyRr × yyrr

Progenies :

♀ / ♂	yr
YR	YyRr Yellow round
Yr	Yyrr Yellow elongated
yR	yyRr White round
yr	yyrr White elongated

Phenotypic ratio = 1 yellow round : 1 yellow elongated : 1 white round : 1 white elongated
Genotypic ratio = 1 YyRr : 1 Yyrr : 1 yyRr : 1 yyrr

(iv) When plant YyRr is self pollinated, 9:3:3:1 ratio of phenotype will be observed. This can be explained as follows :

Parents : YyRr × YyRr

Progenies :

♀ / ♂	YR	Yr	yR	yr
YR	YYRR (Yellow round)	YYRr (Yellow round)	YyRR (Yellow round)	YyRr (Yellow round)
Yr	YYRr (Yellow round)	YYrr (Yellow elongated)	YyRr (Yellow round)	Yyrr (Yellow elongated)
yR	YyRR (Yellow round)	YyRr (Yellow round)	yyRR (White round)	yyRr (White round)
yr	YyRr (Yellow round)	Yyrr (Yellow elongated)	yyRr (White round)	yyrr (White elongated)

Phenotypic ratio = 9 yellow and round : 3 yellow and elongated : 3 white and round : 1 white and elongated. Genotype of plant with yellow flower and elongated fruit will be Yyrr and YYrr.

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266. Study the given figure and answer the following

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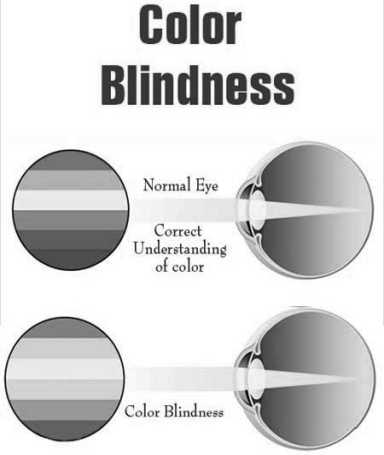


(i) The gene of colour blindness is present on which Chromosome.

(ii) Why It is called criss-Cross inheritance ?

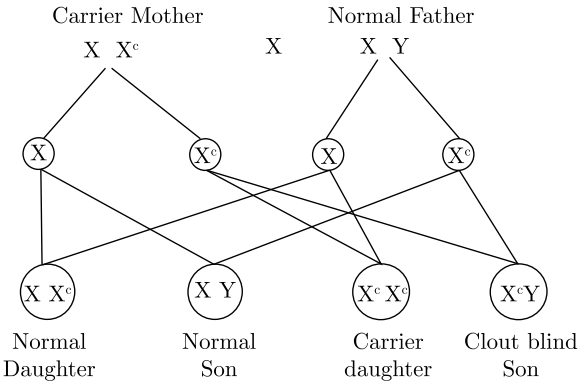
(iii) Work out a cross showing colour blind boy from the carries mother and normal father.

Ans :

(i) X-Chromosome

(ii) Because it is sex-linked inherited and its Character is transmitted from mother to sons and father to daughters.

(iii)



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(iii) Give the genotype of offsprings 1,2,3 and 4 in III generation.

(iv) In this type of inheritance pattern, out of male and female children which one has less probability of receiving the trait from the parents? Give a reason.

Ans :

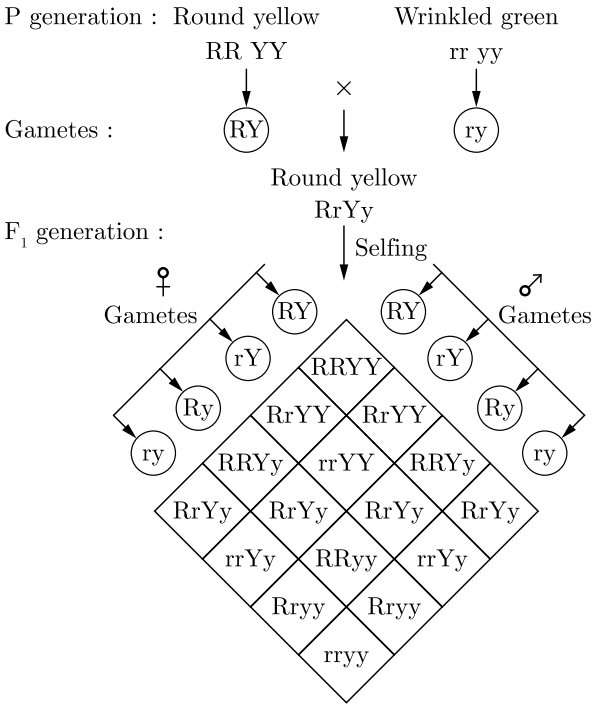
(i) X- linked, recessive trait

(ii) 100%

(iii) Genotype of offsprings 1, 2, 3 and 4 in III generation would be XY, X^aX^a, X^aY and XX respectively where 'a' represents the trait.

(iv) The possibility of the female getting the trait is less. The female will get the trait only if the mother is at least a carrier and the father is affected.

269. A geneticist crosses round yellow seeded pea plant to wrinkled green seeded pea plant and observed the inheritance of both traits as per the following pattern. He collected total 1600 seeds in F_2 generation.



(i) What would be the total number of seeds that are homogenous for yellow colour and heterogenous for round seed shape?

(ii) What phenotypic ratio would be obtained if the plants of F_1 generation would be crossed with homogenous wrinkled green seeded plant?

(iii) How many seeds would be homogenous for wrinkled yellow and wrinkled green?

(iv) Explain the "law of independent assortment" according to the given dihybrid cross.

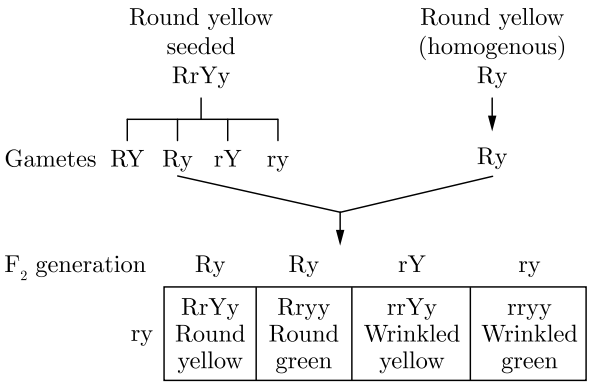
Ans :

The given cross represents the dihybrid cross. The total number of seeds produced in F_2 generation are 1600.

(i) The analysis of cross reveals that the number of homogenous seeds for yellow colour are 4 out of 16 and heterogeneous for round seed shape are 8 out of 16.

Therefore, the total number of seeds homogenous for yellow colour and heterogeneous for round seed shape are: = $4/16 \times 1600 = 400$ and $8/16 \times 1600 = 800$

(ii) The cross between F_1 hybrids with wrinkled green (homogenous) seeded plants can be explained with the help of following cross :



The phenotypic ratio of F_2 generation is 1:1:1:1.

(iii) According to the given cross, the seeds homogenous for wrinkled yellow are 1/16. Homogenous wrinkled yellow seeds = $1/16 \times 1600 = 100$.

Therefore, the total number of homogenous wrinkled yellow seeds obtained is 100.

According to the given cross, the seeds homogenous for wrinkled green are 1/16. Homogenous wrinkled green seeds = $1/16 \times 1600 = 100$

Therefore, the total number of homogenous wrinkled green seeds obtained is 100.

(iv) Law of independent assortment states that the allele of two pairs of a trait separate independently of each other during gamete or spore formation and get randomly rearranged in the offspring at the time of fertilisation producing both parental and new combination of traits. This can be explained by the following typical example of Mendelian dihybrid cross.

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Mendel performed crosses involving two characters. They are called dihybrid crosses that made to study inheritance of two pairs of genes. The classical example of dihybrid cross given below is the use of two pairs of characters namely the seed colour and seed shape. The plants with yellow and round seeds (pure) were crossed with those having green and wrinkled seeds (pure). The F_1 seeds were yellow and round. F1 plants were selfed and F_2 seeds obtained which showed all the four possible combinations, i.e.,

(a) yellow and round seeds,
(b) yellow and wrinkled seeds,
(c) green and round seeds and
(d) green and wrinkled seeds in 9 : 3 : 3 : 1 ratio. It can be shown by the following cross :

Parents : Yellow round × Green wrinkled
YYRR yyrr
Gametes : YR yr
YyRr (Yellow round)
F_1 Generation :
Selfing
Gametes of F_1 :

♀ \ ♂	YR	Yr	yR	yr
YR	YYRR (Yellow round)	YYRr (Yellow round)	YyRR (Yellow round)	YyRr (Yellow round)
Yr	YYRr (Yellow round)	YYrr (Yellow wrinkled)	YyRr (Yellow round)	Yyrr (Yellow wrinkled)
yR	YyRr (Yellow round)	YyRr (Yellow round)	yyRr (Green round)	yyRr (Green round)
yr	YyRr (Yellow round)	Yyrr (Yellow wrinkled)	yyRr (Green round)	yyrr (Green wrinkled)

F_2 Generation :

Phenotypic ratio : Yellow round : Green round : Yellow wrinkled : Green wrinkled
9 : 3 : 3 : 1

270. The cytological observations made in a number of insects led to the development of the concept of genetic/chromosomal basis of sex-determination. Henking (1891) could trace a specific nuclear structure all through spermatogenesis in a few insects, and it was also observed by him that 50 per cent of the sperm received this structure after spermatogenesis, whereas the other 50 per cent sperm did not receive it. Henking gave a name to this structure as the X body but he could not explain its significance. Further investigations by other scientists led to the conclusion that the 'X body' of Henking was in fact a chromosome and that is why it was given the name X-chromosome. It was also observed that in a large number of insects the mechanism of sex determination is of the XO type, i.e., all eggs bear an additional X-chromosome besides the other chromosomes (autosomes). On the other hand, some of the sperms bear the X-chromosome whereas some do not. Eggs ertilised by sperm having an X-chromosome become females and, those fertilised by sperms that do not have an X-chromosome become males. Grasshopper is an example of X0 type of sex determination in which the males have only one X-choromosome besides the autosomes, whereas females have a pair of X-chromosomes. Insects and mammals including man, XY type of sex determination is seen where both male and female have same number of chromosomes.

Among the males an X-chromosome is present but its counterpart is distinctly smaller and called the Y-chromosome. Females, however, have a pair of X-chromosomes. Both males and females bear same number of autosomes. Hence, the males have autosomes plus XY, while female have autosomes plus XX. In human beings and in Drosophila the males have one X and one Y chromosome, whereas females have a pair of X chromosomes besides autosomes. Males produce two different types of gametes, (a) either with or without X-chromosome or (b) some gametes with X-chromosome and some with Y-chromosome. Such types of sex determination mechanism are designated to be the example of male heterogamety. Organisms, e.g., birds a different mechanism of sex determination is observed. In this case the total number of chromosome is same in both males and females. But two different types of gametes in terms of the sex chromosomes are produced by females, i.e., female heterogamety. In order to have a distinction with the mechanism of sex determination described earlier, the two different sex chromosomes of a female bird has been designated to be the Z and W chromosomes. In these organisms the females have one Z and one W chromosome, whereas males have a pair of Z-chromosomes besides the autosomes.

(i) Organism that have XO type of sex-determination?
(ii) What factors determines a human child's sex?
(iii) Which type of sex chromosome found in female bird?
(iv) Name the gametes produces by males?

NODIA

Ans :

(i) Grasshopper

(ii) Sex of a human child in determined by sex chromosome of father.

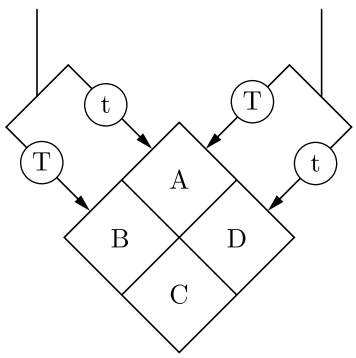
(iii) Female bind has been designated to be the Z and W chromosomes.

(iv) Males produce two different types of gametes:
(a) X-chromosome (with or without)
(b) X-chromosome and Y-chromosome

271. Look at the diagram and answer the following questions.

Tall plant × Tall plant : Phenotype

Tt Tt : Genotype



(i) Write the genotypes of A, B, C, D.

(ii) Write the phenotypes of A, B, C, D.

(iii) Write phenotypic and genotypic ratio of progeny.

(iv) Write the conclusions Mendel arrived at on dominance of traits on the basis of monohybrid crosses that he carried out in pea plants.

Ans :

(i) A - Tt
B - TT
C - Tt
D - tt

(ii) A - Tall
B - Tall
C - Tall
D - Dwarf

(iii) Phenotypic ratio is 3 : 1; Tall : Dwarf
Genotypic ratio of progeny is

TT Tt tt
1 : 2 : 1
Homozygous : Heterozygous : Dwarf
tall tall

(iv) Whenever Mendel carried out a cross between plants for a contrasting trait he found that only one trait out of the two appears in the F1 generation. He concluded that the trait which is expressed in F1 is dominant while the one which remains hidden is recessive. He also said that characters are controlled by discrete unit called factors which occur in pair.

272. The establishment of sex through differential development in an individual at the time of hygote formation is called sex determination.
The specific nuclear structure was traced by Henking in the year 1891 through spermatogenesis. He observed that 50% of sperm received this specific strucure after sperm atogenesis while, the other 50% did not receive it.

(i) How many types of parents are there on the basis of the type of allosome (2)

(ii) What do male hererogamety means (1)

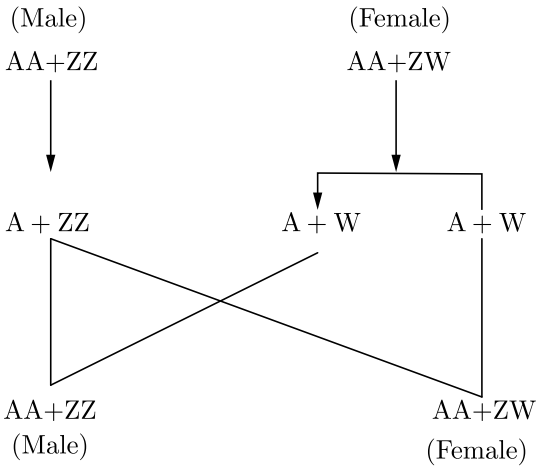
(iii) Draw a cross showing sex determination in birds.

Ans :

(i) The parents can be of two types i.e.,
(a) Homegametic
(b) Heterogametic

(ii) The mechanism in which male produces two different types of gametes is a way either with or without X chromosome or sense with X and some without Y chromosome.

(iii)



273. Colour-blindness is a sex-linked recessive disorder that result in defect in either red or green cone of eye. It does not mean not seeing any colour at all, in fact it leads to the failure in discrimination between red and green colour.

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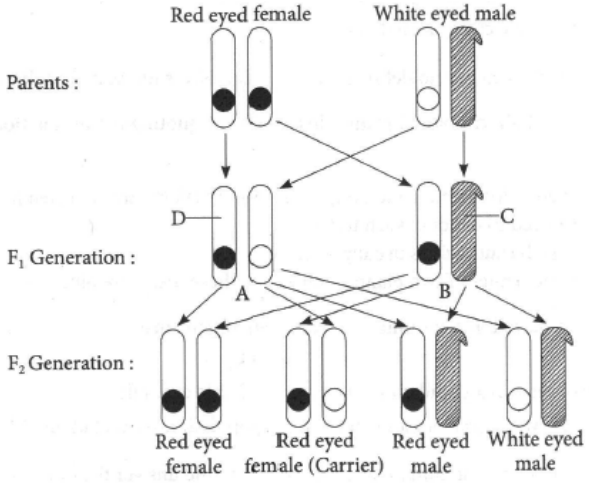


(i) Identify A, B, C and D from the given figure.

(ii) What kind of inheritance is shown in the given the figure?

(iii) State the significance of this inheritance in the above mentioned cross.

(iv) What would happen in the given cross if the parents phenotype be reversed i.e., white eyed female and red eyed male respectively?

Ans :

(i) The given cross shows Morgans' experiment on Drosophila. 'A' is red eyed carrier female, 'B' is red eyed male, 'C' is Y-chromosome and 'D' is X-chromosome carrying eye colour gene.

(ii) Here, the eye colour gene is linked to sex chromosome and is present of X-chromosome showing criss-cross inheritance.

(iii) In criss-cross inheritance, the trait is transferred from parent to grand child of same sex through offspring of the opposite sex. A father transmits his traits to his grandson through daughter while a mother transmits the traits to her granddaughter through her son.

(iv) In the given cross, if the parents phenotype will be reversed, i.e., cross between white eyed female and red eyed male then it will result into the red eyed female that are carrier and normal white eyed male.

267. In a dihybrid cross white eyed, yellow bodied female Drosophila is crossed with red eyed, brown bodied male Drosophila. 1.3% recombinants and 98.7% progeny with parental type combinations were produced in F_2 generation. This observation deviated from Mendelian F_2 phenotypic dihybrid ratio.

(i) What could be the most probable reason for the deviation of the cross from Mendelian ratio?

(ii) Who first conducted the given cross?

(iii) How the physical distance between two genes work in such type of crosses?

(iv) If number of offspring obtained in the above case is 847, then what will be the number of recombinants?

Ans :

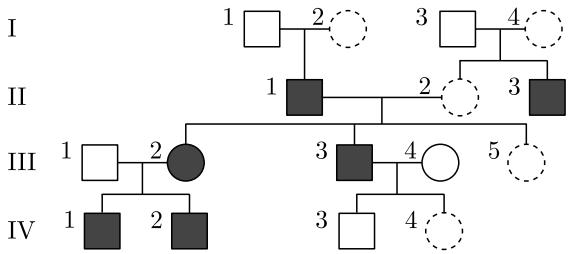
(i) In the given cross, fewer recombinants are formed. This means that the genes show incomplete linkage.

(ii) Morgan carried out several dihybrid crosses in Drosophila to study genes that were sex-linked.

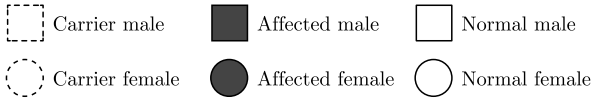
(iii) The physical distance between two genes determines the strength of the linkage and the frequency of the crossing over between two genes. The strength of the linkage increases with the closeness of the two genes. On the other hand the frequency of crossing over increases with the increase in the physical distance between the two genes.

(iv) 1.3% recombinants were produced. Since total number of offspring is 847, the number of recombinants will be $\frac{1.3}{100} \times 847 = 11$ offsprings.

268. Study the Pedigree chart given below and answer the questions that follow:



Symbols used in the given pedigree chart are as follows :



(i) On the basis of the inheritance pattern exhibited in this pedigree chart, what conclusion can you draw about the pattern of inheritance?

(ii) If the female is homozygous for the affected trait in this pedigree chart, then what percentage of her sons will be affected ?

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CHAPTER 5

MOLECULAR BASIS OF INHERITANCE

SUMMARY

1. THE DNA

The proteins are considered ideal molecules to be the genetic material. Proteins are made up of twenty types of **amino acids**. DNA acts as the **genetic material** rather than proteins.

(a) **Transformation :** It is "the phenomenon by which the DNA isolated from one type of cell, when introduced into another type, is able to express some of the properties of the former to the later."

(b) **Transforming Principle : S.F. Griffith**, a British Medical officer proved that "DNA is the hereditary material by his transformation experiment with Streptoccus pneumoniae."

(c) **Hershey and Chase** (1952) showed the transduction experiment with *E*. coli for the role of DNA.

2. STRUCTURE OF POLYNUCLEOTIDE CHAIN (DNA OR RNA)

DNA or RNA consists of a chain **nucleotides**. **Double helical structure of DNA** was proposed by **Watson and Crick** in 1953. DNA has 4 kinds of basic units, the **nucleotides. Linus Pauling** received the **Noble Prize** for unravelling the helical structure of proteins and through that DNA consists of three strands.

E. Chargaff (1949) formulated **Chargaff Rules.**

(i) $A + G = T + C$, (ii) $A = T$; $G = C$.

3. RNA WORLD

It is a polynucleotide chain having **pentose sugar** as **ribose** and A,G,C,U **nitrogenous bases**. The RNA's are **single stranded** (ss). Some has **double strands** (ds). In some viruses, RNA acts as **genetic material**. These are three types of RNA-r-RNA, m-RNA and t-RNA. Among these three r-RNA is **largest**. Essential processes of life evolved around RNA.

4. DNA AND GENSE

The bases of DNA are important as they play role in transmission of hereditary characters. Short segments of DNA form genes.

5. PROPERTIES OF GENETIC MATERIAL (DNA VERSUS RNA)

It was established from Hershey and Chase experiment that "DNA is genetic material." In some viruses, RNA is a genetic material.

6. DNA REPLICATION -MACHINERY AND THE ENZYMES

DNA is "master molecule of body". Meselson and Stahl showed that **"DNA replication is semiconservat."** *E*. coli needs a set of enzymes for it-DNA dependent DNA polymerase. In *E*. coli replication is completed in 38 minutes (average 2000 bp per second). Many other enzymes are also needed. A particular from, where the intertwined DNA start separating is known as the **origin of replication**. **Helicases** are the enzymes which unwind DNA helix. **Topiosomerases** are the enzymes which can break and reseal one strand of DNA **Primer** is a short stretch of RNA formed on DNA templates. **Primase** is the enzyme which polymerises the RNA building blocks (AUGC) into the primer.

7. MECHANISM OF REPLICATION OF DNA

It is complicated and several enxymes take part in it. It was suggested by **Watson** and **Crick**. It was **semi-conservative**. The enzyme **DNA polymerase** helps in adding the building blocks to the primer in a sequence as influenced by the template. The small fragment of DNA formed on lagging strand in 5'-3' direction stating from a RNA primer during replication of DNA are called **Okazaki fragments**. (These fragments are joined together by the enzyme **DNA ligase**). The strand that supports **continuous DNA synthesis** is **leading strand** while which is replicated in **short stretches** in **lagging strand**.

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	Haemophila	Thalassemia
(i)	Sex-linked recessive disorder.	Autosomal linked recessive disorder.
(ii)	Occurs due to presence of sex linked gene h carried by X-chromosome.	Occurs due to mutation or deletion of genes controlling formation of globin chains of haemoglobin.
(iii)	Follows criss-cross inheritance.	Inheritance is straight from both the parents to all the offspring.
(iv)	Due to absence of anti-haemophiliac globulin and plasma thromboplastin factor IX, the blood does not clot and patient continue to bleed even from a minor cut.	There is reduced synthesis of either α or β chains of haemoglobin which causes anaemia, jaundice, hepatosplenomegaly, cardiac enlargement and skeletal deformities.

263. 1. Why is haemophilia generally observed in human males? Explain the conditions under which a human female can be haemophilic.

2. A pregnant human female was advised to undergo M.T.P. It was diagnosed by her doctor that the foetus she is carrying has developed from a zygote formed by an XX-ege fertilised by Y-carrying sperm. Why was she advised to undergo M.T.P.?

Ans : **DELHI 2005**

1. Haemophilia is a sex-linked recessive disorder. Haemophilia (= haemophilia) is genetically due to the presence of a recessive sex linked gene h, carried by X chromosome. A female becomes haemophilic only when both its X chromosomes carry the gene (X^hX^h). However, such females generally die befor birth because the combination of these two recessive alleles is lethal. A female having only one allele for haemophilia (XX^h) appears normal because the allele for normal blood clotting present on the other X chromosome is dominant. Such females are known as carriers. In case of males, a single gene for the defect is able to express itself as the Y chromosome is devoid of any corresponding allele (X^hY) . The possibility of human female becoming haemophilic is extremely rare because she has to be homozygous recessive for the trait, i.e., her father must be a haemophilic and mother must be at least a carrier.

2. M.T.P. (Medical Termination of Pregnancy) is an intentional or voluntary termination of pregnancy before full term. The pregnancy human female was advised to undergo MTP because, the zygote is formed by an additional copy of X-chromosome resulting into a karyotype of 47 with XXY. Such an individual will develop Klinefelter's syndrome. Such persons are sterile males with undeveloped testes, mental retardation, female like sparse body hair, and knock knees, long limbs and with some female characteristics such as feminine pitched voice and enlarged breasts (gynaecomastia).

CASE BASED QUESTIONS

264. The chromosome number is fixed for all normal organisms leading to species specification whereas any abnormality in the chromosome number of an organism results into abnormal individuals. For example, in humans 46 is the fixed number of chromosomes both in male and female. In male it is '44 + XY' and in female it is '44 + XX'. Thus the human male is heterogametic, in other words produces two different types of gametes one with '22 + X' chromosomes and the other with '22 + Y' chromosomes respectively. Human female, on the other hand is homogametic i.e. produces only one type of gamete with '22 + X' chromosomes only.

Sometimes an error may occur during meiosis of cell cycle, where the sister chromatids fail to segregate called non-disjunction, leading to the production of abnormal gametes with altered chromosome number. On fertilisation such gametes develop into abnormal individuals.

(i) State what is aneuploidy.

(ii) If during spermatogenesis, the chromatids of sex chromosomes fail to segregate during meiosis, write only the different types of gametes with altered chromosome number that could possibly be produced.

(iii) A normal human sperm (22 + Y) fertilises an ovum with karyotype '22 + XX'. Name the disorder the offspring thus produced would suffer from and write any two symptoms of the disorder.

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It may occur at transcriptional level, processing level at transport of mRNA to cytoplasm and at translation level also.

19. INDUCIBLE CONTROL

The regulation of gene activity was described by F.Jacob and J. Monod (1961) when they were studying lactose metabolism in *E*. coli. All genes controlling metabolic pathway constitute **operon**. In **lac-oepron**, a **polycistronic structural gene** is regulated by a promotor and regulatory gene. Such arrangement in bacteria is known as operon. Some other names are lac-operon, Val-operon, his-operon, trp-operon etc.

20. REPRESSIBLE CONTROL

Jacob and **Monod** explained that when **tryptophan** is present in growth medium, *E*.coli (will type) cells **repress** synthesis of essential enzymes.

Regulation of **lac-operon** by the **repression** is termed as **negative regulation**.

21. SHUFFLING OF GENES

Shuffling of Genes from one location to another is possible based on similarity of DNA sequences flanking such genes (these genes are known as jumping genes).

22. DNA FINGERPRINTING

This techniques was developed by A. Jaffreys in 1985 with his co-worker. This modern technique is called DNA profiling or DNA typing. It is useful technique in forensic cases.

23. PRINCIPLE BEHIND DNA FINGERPRINTING

The **Mechanism of DNA Fingerprinting** is as follows :

1. **Extraction :** DNA is extracted from the small amounts of blood, semen or hair bulbs available.
2. **Amplification :** Many copies of this DNA are made by a technique called polymerase. Chain Reaction or **PCR (Karry Mullis)**.
3. **Restriction Digestion :** DNA is cut into desired reproducible segments using restriction enzymes.
4. **Separation :** These DNA sequences (restriction fragments) are separated by Gel electrophoresis.
5. **Southern Blotting :** The separated DNA sequences are transferred from gel onto a nitro cellulose membrane.
6. **Hybridisation** with probe, the DNA sequence complementary to **VNTR sequences.**
7. **Exposure of the Membrane** to X-ray film, whose specific bands are developed.

It is used effectively in forensic science for identifying :

(i) The biological father.
(ii) The criminals such as murderers and rapists.

24. HYPERVARIABLE REGIONS

Posses **VNTR's** or **variable number of Tandem Repeats**. They are specific for each individual except the monozygotic twins. Variation occur due to mutations, invertions or small deletions. DNA is cut into specific fragments by **restriction endonulcease enzyme**. The cut DNA posses different lengths in different individuals. This phenomenon is called **restriction fragment length polymorphism (RFLP).**

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25. VNTR

Short repetitive nucleotide sequences are significant for **DNA fingerprinting**. They vary from person to person. These are **Variable Number Tandem Repeats** or **VNTR for short.** The VNTR of two individuals may be of the same length and sequences at some sites and differ at other. DNA samples are digested with restriction enzymes. DNA from different persons yield specific patterns when subjected to **gel electrophoresis.**

26. GEL ELECTROPHORESIS

Electrophoresis is "a technique for analysis and separation of colliods based on the movement of charged particles in the electric field. In gel electrophosesis, the medium is a gel usually made of **agarose, starch** or **polycrylamide**. It is used in the study of mixtures of proteins and nucleic acid etc.

27. GENE LIBRARY

A **gene library** is "a collection of multiple copies of desired DNA or genes." It occurs in bacterial clones with r-DNA. c-DNA. Library is a collection of different c-DNA segments. It is needed in cloning. It is done by r-DNA technique or technique or genetic engineering.

28. GENE BANK

It refers "to the repository of clones of known DNA fragments, genes, seeds, spores, eggs or embryos". It is called genomic library too.

Ans : OD 2009

Anticodon is a sequence of three bases on TRNA which binds to mRNA codon during translation process.
Thus (c) is correct option.

21. RNA differs from DNA is containing:
(a) phosphate (b) ribose
(c) deoxyribose (d) cytosine

Ans : OD 2009

RNA contain ribose sugar while DNA posses deoxyribose sugar.
Thus (c) is correct option.

22. The final proof for DNA as the genetic material came from the experiment of :
(a) Hershey and chase
(b) Avery, Mcleod and McCarty
(c) Hargobind Khorana
(d) Griffith

Ans : DELHI 2005

Hershey and Chase proved that DNA as genetic material. They used bacteriophage for their experiment.
Thus (a) is correct option.

23. DNA fragments are
(a) Negatively charged
(b) Neutral
(c) Either positively or negatively charged depending on their size
(d) Positively charged

Ans : COMP 2012

DNA fragments are negatively charged because of presence of phosphate group.
Thus (a) is correct option.

24. Which of the following RNAs should be most abundant in animal cell?
(a) t-RNA (b) m-RNA
(c) mi-RNA (d) r-RNA

Ans : OD 2015

Ribosomal RNA (rRNA) is most abundant in animal cell. It constitutes 80% of total RNA of the cell.
Thus (d) is correct option.

25. The association of histone H1 with a nucleosome indicates
(a) DNA replication is occurring.
(b) The DNA is condensed into a Chromatin Fibre.
(c) The DNA double helix is exposed.
(d) Transcription is occurring.

Ans : FOREIGN 2016

The association of H1 protein indicates the complete formation of nucleosome which requires DNA condensation. The DNA is therefore in condensed form.
Thus (b) is correct option.

26. A complex of ribosomes attached to a single strand of RNA is known as
(a) Polysome
(b) Polymer
(c) Polypeptide
(d) Okazaki fragment

Ans : DELHI 2005

A polysome or polyribosome is a complex of an mRNA molecule and two or more ribosomes, which is formed during the active translation process. They were initially names as ergosomes in 1963. However, further research by Jonathan Warner and Alex Rich characterized polysome.
Thus (a) is correct option.

27. In sea urchin DNA, which is double stranded, 17% of the bases were shown to be cytosine. The percentages of the other three bases expected to be present in this DNA are
(a) G 17%, A 16.5%, T 32.5%
(b) G 17%, A 33%, T 33%
(c) G 8.5%, A 50%, T 24.5%
(d) G 34%, A 24.5%, T 24.5%

Ans : DELHI 2018

Chargaff's rule states that $A = T$ and $G \equiv C$. The molar amount of adenine = molar amount of thymine. The molar amount of guanine = molar amount of cytosine.

Hence, G is 17% so, C = 17%

A = 33% so, T = 33%

Thus (b) is correct option.

28. Which one of the following is not applicable of RNA?
(a) 5' phosphoryl and 3' hydroxyl ends.
(b) Heterocyclic nitrogenous bases.
(c) Chargaff's rule.
(d) Complementary base pairing.

Ans : SQP 2020

Chargaff's rule is not applicable to RNA.
Thus (c) is correct option.

29. Transformation was discovered by :
(a) Moselson and Stahl
(b) Hershey and Chase

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Ans : OD 2016
There are an average 10 base pairs in one complete rotation (twist) of B-DNA.
Thus (b) is correct option.

11. How many codons are present in inheritance codon?
(a) 4 (b) 16
(c) 32 (d) 64

Ans : OD 2015
The genetic code consists of 64 triplets of nucleotides called as codons. With the exception of three codons, rest 61 codons encodes for one of the 20 amino acids used in the synthesis of proteins.
Thus (d) is correct option.

12. Operon model was proposed by
(a) Watson and crick (b) Nirenberg
(c) Jacob and Monad (d) None of these

Ans : OD 2015
Operon is a group of genes coding for related proteins. It consists of an operator, promoter, regulator and structural genes. Operon model was proposed by Jacob and Monad.
Thus (c) is correct option.

13. Anticodons are present on:
(a) m-RNA (b) r-RNA
(c) t-RNA (d) all of these

Ans : OD 2013
Anticodon are located on t-RNA.
Thus (c) is correct option.

14. Gene for hypertrichosis (having pinna) is present on:
(a) X-Chromosome (b) Y-Chromosome
(c) Sex Chromosome (d) Autosome

Ans : OD 2013
Hypertrichosis pinna is a Y-linked character. In it, long and strong hair grow from the helix of the pinna.
Thus (b) is correct option.

15. Nucleic acids are polymers of:
(a) Nucleotides (b) Nucleosides
(c) Amino acids (d) Nucleoproteins

Ans : OD 2012
Nucleic acid is a long polymer of Nucleotides linked together through phosphodiester bond.
Thus (a) is correct option.

16. Pyrimidines present in DNA are:
(a) Thymine and Cytosine
(b) Adenine and Guanine
(c) Cytosine and Uracil
(d) Thymine and Uracil

Ans : OD 2011
A pyrimidine is a heterocyclic aromatic organic compound containing two nitrogen atoms. It contains only one carbonring. There are three pyrimidines in nucleic acid. Cytosine, Thymine, Uracil. Out of these Cytosine, thymine are found in DNA.
Thus (a) is correct option.

NODIA

17. Nucleoside is:
(a) Sugar + a nitrogenous base
(b) Sugar + phosphate
(c) Nitrogenous base + phosphate
(d) Sugar + a nitrogenous base + phosphate

Ans : OD 2011
Combination of sugar (ribose or deoyribose) and nitrogenous base is called as nucleoside. When phosphate group is added, it becomes nucleotide.
Thus (a) is correct option.

18. Pyrimidines present in RNA are:
(a) Cytosine and Thymine
(b) Adenine and Guanine
(c) Cytosine and Uracil
(d) Thymine and Uracil

Ans : OD 2010
A pyrimidine is a one carbon ringed heterocyclic aromatic organic compound having two nitrogen atoms. Three types of pyrimidines are found in nucleic acids, these are cytosine, Uracil and Thymine. Out of these, cytosine and Uracil are found in RNA.
Thus (c) is correct option.

19. In a DNA molecule, the cytosine is 18%. The percentage of adenine is:
(a) 64 (b) 36
(c) 82 (d) 32

Ans : OD 2009
The Percentage of adenine is 32.
Thus (d) is correct option.

20. A sequence of three bases on tRNA which binds to mRNA codon is:
(a) triplet
(b) non-sense codon
(c) anticodon
(d) termination codon

OBJECTIVE QUESTIONS

1. The human chromosome with highest and least number of genes are:
(a) Chromosome 21 and Y
(b) Chromosome 11 and X
(c) Chromosome 11 and Y
(d) Chromosome X and Y

Ans : OD 2024
The human chromosome with the highest and least number of genes in them are chromosome 21 and Y respectively. Y chromosome represents approximately 1% of the total DNA in male cell while chromosome 21 represents about 8% of the total DNA in human cells.
Thus (a) is correct option.

2. Operon Model is representation of:
(a) Gene synthesis (b) Gene expression
(c) Gene regulation (d) Gene function

Ans : OD 2017
Group of genes coding for related proteins arranged as a unit is known as operon. Operon Model is representation of gene regulation. It consist of an operator, promoter, regulator and structural genes.
Thus (c) is correct option.

3. Which nitrogenous base is absent in DNA ?
(a) Thymine (b) Uracil
(c) Guanine (d) Cytosine

Ans : OD 2017
Uracil are not found in DNA. They possess thymine instead of it. Uracil are present in RNA nucleotide sequence. Uracil binds to adenine via two hydrogen bonds.
Thus (b) is correct option.

4. DNA is genetic material of:
(a) TMV (b) Bacteriophage
(c) Both (d) None

Ans : OD 2017
Bacteriophage possess DNA as their genetic material. It may be double or single stranded. Tobacco Mosaic Virus (TMV) have single stranded RNA.
Thus (b) is correct option.

5. Formation of mRNA is called :
(a) Transcription (b) Replication
(c) Translation (d) None

Ans : OD 2017
The process of formation of mRNA from DNA is called as transcription. mRNA is later converted into protein by translation. Replication is a process of formation of new DNA strand from the old one.
Thus (a) is correct option.

6. Human blood group O has:
(a) antigen absent
(b) antibody absent
(c) antigen present
(d) antibody A present

Ans : OD 2010
Individuals with blood group-O produce neither A or B antigens. Therefore, their blood can be transferred into any recipient of blood group A, B, AB or O. They are called as universal donar.
Thus (a) is correct option.

7. Trisomy $(2n+1)$ causes retardation in child, which is known as:
(a) Philadelphia
(b) Down's Syndrome
(c) Albinism
(d) none of these

Ans : OD 2016
Trisomy in 21st chromosome causes Down's syndrome. It is also called as mongolism.
Thus (b) is correct option.

8. Purine base of DNA molecule has :
(a) A and C (b) C and T
(c) A and G (d) none of these

Ans : OD 2016
Adenine (A) and guanine (G) are purine while cytosine (C) and thymine (T) are pyrimidines.
Thus (c) is correct option.

9. Which type of bonding is present in between nitrogenous bases of nucleic acid?
(a) Peptide bond (b) Ester bond
(c) Both (a) and (b) (d) Hydrogen bond

Ans : OD 2016
Hydrogen bond is found between nitrogenous bases of nucleic acid. Adenine and Thymine form double bond while cytosine and Guanine form Triple bond.
Thus (d) is correct option.

10. How many nitrogen base pairs are present in a complete rotation (twist) of B-DNA:
(a) 5 (b) 10
(c) 15 (d) 20

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(c) Griffith
(d) Watson and Crick

Ans : **COMP 2023**

Frederick Griffith (in 1928), a British Medical officer described the phenomenon of bacterial transformation. He carried out experiment with Streptococcus pneumoniae (bacterium causing pneumonia) which is used to infect mice. By using S Strain (heat killed) and R strain (live) it was concluded that R strain has been transformed by some material of S strain which makes R strain virulent and enable to synthesize smooth polysachharide.
Thus (c) is correct option.

30. Uridine, present only in RNA is a
(a) Pyrimidine (b) Nucleoside
(c) Nucleotide (d) Purine

Ans : **OD 2012**

The combination of pentose sugar with nitrogenous bases (purines or pyrimidines) is called nucleoside. Examples are adenosine, guanosine, cytidine, thymidine and uridine.
Thus (b) is correct option.

31. If one strand of DNA has the nitrogenous base sequence at ATCTG, what would be the complementary RNA strand sequence
(a) TTAGU (b) UAGAC
(c) AACTG (d) ATCGU

Ans : **DELHI 2005**

Sequence of DNA is ATCTG then sequence of m-RNA will UAGAC. As adenine base pairs with uracil and guanine with cytosine.
Thus (b) is correct option.

32. The unequivocal proof of DNA as the genetic material came from the studies on a
(a) bacterium (b) fungus
(c) viroid (d) bacterial virus

Ans : **DELHI 2011**

Bacteriphage was used by Hershey and Chase to prove DNA as genetic material.
Thus (d) is correct option.

33. Infectious proteins are present in
(a) Gemin viruses (b) Prions
(c) Viroids (d) Satellite viruses

Ans : **SQP 2009**

Infections proteins are rich in prions. Prions are made of proteins without nucleic acid. It is the causal agent of scrapie disease of sheep.
Thus (b) is correct option.

34. Which one of the following does not follow the central dogma of molecular biology?
(a) Pea (b) Mucor
(c) Chlamydomonas (d) HIV

Ans : **FOREIGN 2007**

HIV viruses does not follow central dogma. Central dogma is a one way flow of information from DNA to mRNA and then to protein.

DNA $\underset{\text{reverse transcription}}{\overset{\text{transcription}}{\rightleftharpoons}}$ mRNA $\xrightarrow{\text{translation}}$ Protien

Thus (d) is correct option.

35. T.O. Diener discovered a :
(a) free infectious DNA
(b) infectious protein
(c) bacteriophage
(d) free infectious RNA

Ans : **COMP 2006**

Theodor O. Diener discovered the Potato Spindle Tuber viroid ("PSTVd"), the first viroid everidentified, in 1971. PSTVd is a small circular RNA molecular. Dr. Diener discovered that the pathogen causing potato spindle tuber disease is not a virus, as previously believed, but a much smaller, free RNA molecule.
Thus (d) is correct option.

36. The length of DNA molecule greatly exceeds the dimensions of the nucleus in eukaryotic cells. How is this DNA accommodated?
(a) super-coiling in nucleosomes
(b) DNase digestion
(c) through elimination of repititive DNA
(d) deletion of non-essential genes

Ans : **OD 2012**

Option (a) is correct.

37. A sequential expression of a set of human genes
(a) messenger RNA (b) DNA sequence
(c) ribosome (d) transfer RNA

Ans : **DELHI 2005**

A sequential expression of a set of human genes is the DNA sequence. Because gene is the functional part of DNA sequence.
Thus (b) is correct option.

38. During transcription, RNA polymerase holoenzyme binds to a gene promoter and assumes a saddle-like structure, What is its DNA-binding sequence?
(a) AATT (b) CACC
(c) TATA (d) TTAA

NODIA

amino acids, the genetic code is non-over lapping. Three successive nucleotides or bases code for only one amino acid wobbling refers to the third base degeneracy.
Thus (a) is correct option.

74. Exon part of m-RNAs have code for
(a) protein (b) lipid
(c) carbohydrate (d) phospholipid
Ans : **OD 2009**
Exons are the coding part of mRNA.
Thus (a) is correct option.

75. Types of RNA polymerase required in nucleus for RNA synthesis?
(a) 1 (b) 2
(c) 3 (d) 4
Ans : **DELHI 2010**
Eukaryotes have three types of RNA polymerases:
(i) RNA polymerase I- it is found in nucleus and is responsible for r-RNA synthesis.
(ii) RNA polymerase II-It is found in nucleoplasm and is responsible for m-RNA synthesis.
(iii) RNA polymerase III-It is found in nucleoplasm and is responsible for t-RNA and 5-S RNA synthesis.
Thus (a) is correct option.

76. Gene and cistron words are sometimes used synonymously because
(a) one cistron contain many genes
(b) one gene contains many cistrons
(c) one gene contains one cristron
(d) one gene contains no cistron
Ans : **COMP 2005**
Cistron is that segment of DNA which specifies synthesis of a polypeptide.
Thus (c) is correct option.

77. Mutation generally produces
(a) polygenes (b) dominant genes
(c) recessive genes (d) lethal genes
Ans : **COMP 2008**
Polygene is a gene, single dominant allele of which expressed only a unit of the trait, lethal genes on expression stop producing vital products essential for survival of an individual.
Thus (d) is correct option.

78. Protein syntheis occurs
(a) on ribosomes present in sytosol as well as in mitochondria
(b) only on ribosomes attached to the nucler envelope and endoplasmic reticulum
(c) only on the ribosomes present in cytosol
(d) on ribosomes present in the nucleolus as well as cytoplasm
Ans : **DELHI 2006**
Thus (b) is correct option.

79. One function of the telomeres in a chromosome is to
(a) identify the correct number of the homologous pair of chromosomes
(b) help tow chromatids to move towards poles
(c) "seal" the ends of chromosomes
(d) start RNA synthesis
Ans : **SQP 2011**
Seal the ends of chromosomes. The telomere is a "ribonucleo-protein complex" composed of a protein component and an RNA primer sequence which acts to protect the terminal ends of chromosomes. This prevents chromosomal disintegration and prevents the ends of the chromosome from being processed as a double strand DNA break, which could lead to chromosome-to-chromosome telomere fusions.
Thus (c) is correct option.

80. Anticodon is an unparied triplet of bases in an exposed position of
(a) mRNA (b) rRNA
(c) tRNA (d) sRNA
Ans : **SQP 2005**
tRNA works as an adaptor molecules for carrying amino acid to the mRNA templated during protein synthesis. It bears anticodon and recognizes the specific codon on mRNA.
Thus (c) is correct option.

81. DNA replication is
(a) conservative and discontinuous
(b) semiconservative and semi discontinuous
(c) semiconservative and discontinuous
(d) conservative
Ans : **FOREIGN 2012**
In semi conservative replication of DNA in each replica one half is the old strand and the other half is a new strand synthesized over it.
Thus (b) is correct option.

82. What base is responsible for hot spots for spontaneous point mutations?
(a) Adenine (b) 5-bromouracil
(c) 5-methycytosine (d) Guanine

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(c) DNA dependent DNA polymerase
(d) RNA dependent DNA polymerase

Ans : **OD 2007**

H. Temine and D. Baltimore (1970) discovered that tumor viruses contain RNA as genetic material and replicate by synthesizing complementary DNA. This process is called reverse transcription and it is carried by an RNA dependent DNA polymerase called as reverse transcriptase.
Thus (d) is correct option.

49. In DNA, when AGCT occurs, their association is as per which of the following pairs?
(a) AG-CT (b) AC-GT
(c) AT-GC (d) All of these

Ans : **OD 2013**

In DNA adenine always pairs with thymine and guanine always pairs with cytosine, this is called complementary base pairing.
Thus (c) is correct option.

50. The Pneumococcus experiment proves that
(a) DNA is the genetic material
(b) Bacteria undergo binary fission
(c) Bacteria do not reproduce sexually
(d) RNA sometime controls the production of DNA and proteins

Ans : **DELHI 2017**

Griffith's experiment with **Pneumococcus** proves that DNA is the genetic material.
Thus (a) is correct option.

51. How many base pair (bp) are found in the haploid genome of humans?
(a) 2.9×10^9 (b) 4×10^8
(c) 7×10^9 (d) 3×10^9

Ans : **FOREIGN 2012**

The number of base pairs (bp) found in the haploid genome of human is 3×10^9.
Thus (d) is correct option.

52. The eukaryotic genome differs from the prokaryotic genome because
(a) genes in the former case are organised into operons
(b) the DNA is complexed with histones in prokaryotes
(c) repetitive sequences are present in eukaryotes
(d) the DNA is circular and single stranded in prokaryotes

Ans : **COMP 2011**

Thus (b) is correct option.

53. A DNA with unequal nitrogen bases would most probably be
(a) single stranded (b) double stranded
(c) triple stranded (d) four stranded

Ans : **2011**

A single strand of DNA would not posses complementary base pairs. Hence nitrogenous bases are unequal in number.
Thus (a) is correct option.

54. Nucleotide arrangement in DNA can be seen by
(a) X-ray crystallography
(b) electron microscope
(c) ultracentrifuge
(d) light microscope

Ans : **COMP 2022**

In 1953 Wilkins obtained very fine X-ray crystallographic pictures of DNA from which Watson and Crick developed the double helix model of DNA.
Thus (a) is correct option.

55. Who proved that DNA is basic genetic material?
(a) Griffith
(b) Watson
(c) Boveri and Sutton
(d) Hershey and chase

Ans : **DELHI 2006**

Hershey and Chase (1952) worked on Escherichia coli and conclusively proved that DNA is the genetic material.
Thus (d) is correct option.

56. The transforming principle of Pneumococcus as found out by Avery, MacLeod and McCarty was
(a) mRNA (b) DNA
(c) protein (d) polysaccharide

Ans : **SQP 2008**

The transforming chemical discovered by Griffith in his experiments with Pneumococcus, was confirmed as DNA by Avery, McLeod and McCarty.
Thus (b) is correct option.

57. Nucleosome core is made of
(a) H1, H2A, H2B and H3
(b) H1, H2A, H2B, H4
(c) H1, H2A, H2B, H3 and H4
(d) H2A, H2B, H3 and H4

Ans : **FOREIGN 2011**

The four histone proteins constituting the core of nucleosome are H2A, H2B, H3, H4.
Thus (d) is correct option.

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Ans : FOREIGN 2005

The DNA binding sequence for RNA polymerase is called TATA box.
Thus (c) is correct option.

39. The two polynucleotide chains in DNA are
(a) discontinuous (b) antiparallel
(c) semi conservative (d) parallel

Ans : SQP 2009

The two chains are antiparallel, one aligned in $5' \rightarrow 3'$ direction the other in $3' \rightarrow 5'$ direction.
Thus (b) is correct option.

40. Which antibiotic inhibits interaction between RNA and mRNA during bacterial protein synthesis?
(a) Neomycin (b) Streptomycin
(c) Tetracycline (d) Erythromycin

Ans : OD 2024, 2006

Neomycin is the antibiotic which inhibits the translation of bacterial cell so that it can not affect the host cell.
Thus (a) is correct option.

41. The following ratio is generally constant for a given species :
(a) $\frac{A+G}{C+T}$ (b) $\frac{T+C}{G+A}$
(c) $\frac{G+C}{A+T}$ (d) $\frac{A+C}{T+G}$

Ans : COMP 2010

According to Chargaff purines and pyrimidines are in equal amounts. Purine (adenine) is equimolar with pyrimidine (thymine) and purine (guanine) is equimolar with pyrimidine (cytosine).
Thus (c) is correct option.
Base ratio $\frac{A+T}{C+G}$ is specific for species.

42. DNA template sequence of CTGATAGC is transcribed over mRNA as
(a) GUCTUTCG (b) GACUAUCG
(c) GAUTATUG (d) UACTATCU

Ans : DELHI 2012

During transcription, from the DNA template complementary mRNA is formed and thymine is replaced by uracil.
Thus (b) is correct option.

43. Extranuclear inheritance occurs in
(a) peroxisome and ribosome
(b) chloroplast and mitochondria
(c) mitochondria and ribosome
(d) chloroplast and lysosome

Ans : FOREIGN 2015

In eukaryotic cells, two cytoplasmic organelles, mithochondria and chloroplast of green plants, contain their own genetic materials.
Thus (b) is correct option.

44. Which form of RNA has a structure resembling clover leaf?
(a) rRNA (b) hn RNA
(c) m RNA (d) t RNA

Ans : SQP 2017

rRNA occurs inside ribosomes. mRNA carries information from DNA to polypeptides. hnRNA are hetergoneous nuclear RNA
Thus (d) is correct option.

45. Transformation experiment was first performed on which bacteria?
(a) *E*. coli
(b) Diplococcus pneumoniae
(c) Salmonella
(d) Pasteurella pestis

Ans : OD 2022

Transformation is change in genetic material of an organism by obtaining genes from outside.
Thus (b) is correct option.

46. In a DNA percentage of thymine is 20% then what will be the percentage of guanine?
(a) 20% (b) 40%
(c) 30% (d) 60%

Ans : SQP 2008

According to Chargaff's rule, the ratio of purine bases to pyrimidine bases is equal

$$A = T,\ C = G$$

If T is 20% then A is 20% and C and G are 30%, 30%
Thus (c) is correct option.

47. Extra-nuclear inheritance occurs in
(a) Killer strain in paramecium
(b) Colour blindness
(c) Phenylketonuria
(d) Tay sach disease

Ans : COMP 2010

Colour blindness follows sex-linked inheritance. Pheynylketonuria is an in born error of metabolism.
Thus (a) is correct option.

48. Reverse transcriptase is
(a) RNA dependent RNA polymerase
(b) DNA dependent RNA polymerase

NODIA

Ans : **FOREIGN 2015**

Genetic code is non ambiguous. There is no ambiguity for particular codon. A particular codon will always code for the same amino acid, where ever it is found.
Thus (b) is correct option.

67. Whose experiments cracked the DNA and discovered unequivocally that a genetic code is a 'triplet'
(a) Hershey and Chase
(b) Morgan and Sturtevant
(c) Beadle and Tantum
(d) Nirenberg and Mathei

Ans : **COMP 2019**

Nirenberg and Mathaei (1961) experimentally proved that a single amino acid is determined by a sequence of three nitrogen bases. The sequence of three nitrogen bases determining a single amino acid is called a triplet code. Nirengerg and Mathaei experiments cracked the DNA and discovered unequivocally that a genetic code is a triplet.
Thus (d) is correct option.

68. Telomerase is an enzyme which is a
(a) simple protein (b) RNA
(c) ribonucleoprotein (d) repetitive DNA

Ans : **COMP 2005**

Telomerase is a ribnucleoprotein which synthesize the rich strand of telomers in DNA. Telomerase is an enzyme that adds specific DNA sequence repeats ("TTAGGG" in all vertebrates) to the 3' ("three prime") end of DNA strands in the telomere regions, which are found at the ends of eukaryotic chromosomes. The telomeres contain condensed DNA material, giving stability to the chromosomes. The enzyme is a reverse transcripatase that carries its own RNA molecule, which is used as template when it elogates telomeres, which are shortened after each replication cycle. Telomerase was discovered by Carol W. Greider in 1984.
Thus (c) is correct option.

69. In a mutational event, when adenine is replaced by guanine, it is a case of
(a) frame shift mutation (b) transcription
(c) transition (d) transversion

Ans : **SQP 2015**

In transition substitution a purine is replaced by another purine base (A with G or vice versa). In transversion substitution a purine is replaced by a pyrimidine base or vice versa. Frameshift mutation is a type of mutation is a type of mutation where the reading of codons is changed due to insertion or deletion of nucleotides. Transition is the formation of RNA over the template of DNA.
Thus (c) is correct option.

70. The telomeres of eukaryotic chromosomes consist of short sequences of
(a) thymine rich repeats
(b) cytosine rich repeats
(c) adenine rich repeats
(d) guanine rich repeats

Ans : **COMP 2016**

Telomeres are non sticky terminals ends of the chromosomes. It has heterochromatin and repetitive DNA.
Thus (c) is correct option.

71. In the genetic code dictionary, how many codons are used to code for all the 20 essential amino acids?
(a) 60 (b) 20
(c) 64 (d) 61

Ans : **OD 2019**

Out of a total of 64 codons, 3 codons to not make any sense. Hence only 61 codons are used in the formation of the 20 essential amino acids (polypeptides).
Thus (d) is correct option.

72. Degeneration of a genetic code is attributed to the
(a) third member of a codon
(b) first member of a codon
(c) second member of a codon
(d) entire codon

Ans : **DELHI 2020**

According to the Wobble hypothesis, tRNA anticodon has the ability to wobble at its 5 end by pairing with even non-complementary base of mRNA codon. It correspond to third base degeneracy of the codons.
Thus (a) is correct option.

73. Out of 64 codons, 61 codons code for 20 types of amino acid. It is called
(a) degeneracy of genetic code
(b) overlapping of gene
(c) wobbling of codon
(d) universality of codon

Ans : **FOREIGN 2022**

Out of 64 codons, only 3 signify stop codons. There are more than one codon for most of the

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58. A nucleotide is formed of
(a) purine, pyrimidine and phosphate
(b) purine, sugar and phosphate
(c) nitrogen base, sugar and phosphate
(d) pyrimidine, sugar and phosphate

Ans : OD 2016

Nucleotide is a unit of DNA, which is formed of nitrogenous bases (urines & Pyrimidines), sugar (Pentose) & phosphate.
Thus (c) is correct option.

59. During DNA replication, Okazaki fragments are used to elogate
(a) The lagging strand toward replication fork.
(b) The leading strand away from replication fork
(c) The lagging strand away from the replication fork
(d) The leading strand towards replication fork

Ans : DELHI 2019

Two DNA polymerase molecules simultaneously work at the DNA fork, one on the leading stand and the other on the lagging strand.
DNA polymerase synthesizes each Okazaki fragment at lagging strand in $5' - 3'$ direction. As the replication fork opens further, new Pkazaki fragments appear. The first Okazaki fragment appears away from the replication fork and thus the direction of elongation would be away from replication fork.
Thus (c) is correct option.

60. Which one of the following is the starter codon?
(a) AUG (b) UGA
(c) UAA (d) UAG

Ans : SQP 2005

The Start codon is the first codon of a messenger RNA (mRNA) franscript translated by a ribosome. The start codon always codes for methionine in eukaryotes and a modified met (fMet) in prokaryotes The most common start codon is AUG.
Thus (a) is correct option.

61. The movement of a gene from one linkage group to another is called
(a) Duplication (b) Translocation
(c) Crossing over (d) Inversion

Ans : DELHI 2016

In translocation, the movement of a gene takes place from one linkage group to another between non-homologous chromosomes.
Thus (b) is correct option.

62. Which of the following is not a property of the genetic code?
(a) Universal (b) Non-overlapping
(c) Ambiguous (d) Degeneracy

Ans : SQP 2010

Genetic code is the relationship of amino acid sequence in a polypeptide and nucleotide/base sequence in mRNA/antisense strand of DNA.
It is universal, i.e., a codon specifies the same amino acid in all organisms, non-overlapping, i.e., adjacent codons are independent with no base being member of two codons, degeneracy, i.e., some amino acids are coded by more than one codon, hence the code is degenerate, unambiguous, i.e., one codon codes for only one amino acid.
Thus (a) is correct option.

63. Removal of RNA polymerase III from nucleoplasm will affect the synthesis of
(a) tRNA (b) hnRNA
(c) mRNA (d) rRNA

Ans : FOREIGN 2008

Removal of RNA polymerase III from nucleoplasm will affect the synthesis of tRNA while RNA polymerase I forms r-RNA and RNA polymerase II form m-RNA is Eukaryotes.
Thus (a) is correct option.

64. Which one of the following is not a part of transcription unit in DNA?
(a) The inducer
(b) A terminator
(c) A promoter
(d) The structural gene

Ans : COMP 2013

Transcription unit consists of promoter, structural gene and terminator.
Thus (a) is correct option.

65. Removal of introns and joining of exons in a defied order during transcription is called
(a) Looping (b) Inducing
(c) Slicing (d) Splicing

Ans : OD 2016

Remonal of introns by spliceosome in hnRNA and joining of exons by DNA liagse in a defined order during transcription is called splicing.
Thus (d) is correct option.

66. The one aspect which is not a salient feature of genetic code, is its being
(a) degenerate (b) ambiguous
(c) universal (d) specific

NODIA

Ans : **OD 2019**

The term "hot spots" was used by Benzer for the sites which are more mutable than other sites. Studies in 1978 revealed that 5-methylcytosine residues occur at the position of the each hot spot.
Thus (c) is correct option.

83. DNA elements which can switch their position are called
(a) exons (b) introns
(c) cistrons (d) transposons

Ans : **FOREIGN 2013**

Transposons are sequences of DNA that can move around to different positions within the genome of a single cell, a process called transposition. In the process, they can cause mutations and change the amount of DNA in the genome. Transposons are also called "jumping genes" or mobile genetic elements" Discovered by Barbara McClintock early in her carrier, the topic went on to be a Nobel wining work in 1983. There are a variety of mobile genetic elements, and they can be grouped based on their mechanism of transposition.
Thus (d) is correct option.

84. Genes that are involved in turning on or off the transcription of a set of structural genes are called
(a) Operator genes
(b) Redundant genes
(c) Regulator genes
(d) Polymorphic genes

Ans : **COMP 2005**

Operator gene allows the functioning of the operon.
Thus (a) is correct option.

85. Which step of translation does not consume a high energy phosphate bond?
(a) Translocation
(b) Amino acid activation
(c) Peptidyl-transferase reaction
(d) Aminoacyl tRNA binding to active ribosomal site

Ans : **OD 2005**

Only the peptidyl-transferase reaction does not require energy. The aminoacyl-tRNA binding to ribosome involves initiation factors and energy (GTP). Amino acid activation requires energy (the cleavage of ATP of AMP and PPi). Translocation requires an elongation factors and energy (GTP).
Thus (c) is correct option.

86. Three codons causing chain termination are
(a) TAG, TAA, TGA
(b) GAT, AAt, AGT
(c) AGT, TAG, UGA
(d) UGA, UGA, UAA

Ans : **SQP 2017**

Termination codons are the stop signals which when encountered cause termination of polypeptide synthesis. They are UAA (ochre), UAG (amber)and UGA (opal). Codons are determined by the sequence of bases on the DNA. Thymine is not present on RNA.
Thus (d) is correct option.

87. A mutation at one base of the first codon, of a gene, produces a non-functional proteins, Such a mutation is called
(a) nonsense mutation
(b) missense mutation
(c) frameshift mutation
(d) reverse mutation

Ans : **COMP 2008**

A mutation bringing about early stoppage of polypeptide formation is called nonsense mutation. Frame shift mutation is a type of gene mutation where the reading of codons is changed due to insertion or deletion of nucleotides.
Thus (b) is correct option.

88. Different mutations referrable to the same locus of a chromosome give rist to
(a) multiple alleles (b) pseudoalleles
(c) polygenes (d) oncogenes

Ans : **COMP 2007**

Multiple alleles are multiple alternatives or alleles of the same gene which occur in the population of same species. Polygene is a gene, single dominant allele of which express only a unit of trait. Polygenes are the genes controlling quantitative inheritances. Oncogenes are the cancer causing genes.
Thus (a) is correct option.

89. During development of an organism, the product of one gene is required to activate another gene. Such gene products are called
(a) transcription factors (b) episomes
(c) coenzymes (d) catalase

Ans : **DELHI 2010**

In eukaryotes separate protein factors take part in recognition and initiation during transcription. They are called transcription factors. Coenzymes are non protein organic cofactors which get loosely attached to apoenzymes during the functioning of holoenzymes.
Thus (a) is correct option.

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termination. Transcription exhibits several termination. Transcription exhibits several features that are distinct from replication.
Thus (a) is correct option.

108. Which enzymes will be produced in a cell in which there is a nonsense mutation in the lac Y gene?
(a) Lactose permease
(b) Transactylase
(c) Lactose permease and transcetylase
(d) β-galactosidase

Ans : **COMP 2010**

A nonsense mutation is the one which stops polypeptide synthesis due to formation of a terminating or non sense codon. e.g., ATT(UAA), ATC(UAG), ACT(UGA). The lactose or lac operon of Esherichia coli contains structural genes (Z,Y,A). If Y codes for termination of polypeptide chain then only the product of 'Z' gene transcribe to form β-galactosidase.
Thus (d) is correct option.

109. In transgenics, expression of transgene in target tissue is determined by
(a) enhancer (b) transgene
(c) promoter (d) reporter

Ans : **OD 2015**

Transgenic organisms are genetically modified organisms.
Thus (b) is correct option.

110. Which one of the following also acts as a catalyst in a bacterial cell?
(a) 5s rRNA (b) sn RNA
(c) hn RNA (d) 23s rRNA

Ans : **SQP 2005**

23s rRNA acts as a catalyst in a bacterial cell.
Thus (d) is correct option.

111. Semi-conservative replication of DNA was first demonstrated in
(a) Escherichia coli
(b) Streptococcus pneumoniae
(c) Salmonella typhimurium
(d) Drosophila melanogaster

Ans : **COMP 2005**

Semiconservative replication of DNA was first demonstrated in Escherichia coli. E. coli is a common type of bacteria that can get into food, like beef and vegetables. The strange thing about these bacteria is that they are not always harmful to you. E. coli normally lives inside your intestines, where it helps your body breakdown and digest the food you eat.
Thus (a) is correct option.

112. One gene-one enzyme relationship was established for the first time in
(a) Salmonella typhimurium
(b) Escherichia coli
(c) Diplocococcus pneumoniae
(d) Neurospora crassa

Ans : **FOREIGN 2012**

It was given by Geneticists George W. Beadle and E.L. Tatum which states that each gene in an organism controls the production of a specific enzyme. It is these enzymes that catalyze the reactions that lead to the phenotype of the organism
Thus (d) is correct option.

113. One gene-one enzyme hypothesis was postulated by
(a) Hershey and Chase (b) A. Garrod
(c) Beadle and Tatum (d) R. Franklin

Ans : **SQP 2016**

Beadle and Tatum postulated the theory of 'One-gene-one-enzyme' in which they stated that in any living cell there are number of genes present on chromosomes in a linear fashion. One single gene controls they synthesis of one particular enzyme (or protein) in the cell which is responsible for its phenotypic character.
Thus (c) is correct option.

114. During transcription holoenzyme RNA polymerase binds to a DNA sequence and the DNA assumes a saddle like structure at that point. What is the sequence called?
(a) AAAT box (b) TATA box
(c) GGTT box (d) CAAT box

Ans : **COMP 2009**

About 28 base pairs from transcription start site are TATA boxes. After 40 bases from TATA boxes appears LAAT boxes. Both of these sequence serve as recognition site in Eukaryotic promoters (Transcription in eukaryotic genes in a far more complicated process than in prokaryotes)
Thus (b) is correct option.

115. Which one of the following makes use of RNA as a template to synthesize DNA?
(a) DNA polymerase
(b) RNA polymerase
(c) Reverse transcriptase
(d) DNA dependant RNA polymerase

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role in non-canonical base pairing in DNA and especial RNA molecules.
Thus (d) is correct option.

99. The process of translation is
(a) ribosome synthesis (b) protein synthesis
(c) dNA synthesis (d) rNA synthesis

Ans : **COMP 2007**

Protein synthesis occurs over ribosomes which are also referred to as protein factories.
Thus (b) is correct option.

100. Because most of the amino acids are represented by more than one codon, the genetic code is
(a) overlapping (b) wobbling
(c) degenerate (d) generate

Ans : **DELHI 2008**

All amino acids are specified by more than one codon (except Tryptophan and Methionine). Hence they are degenerate.
Thus (c) is correct option.

101. Khorana first deciphered the triplet codons of
(a) serine and isoleucine
(b) cysteine and valine
(c) tyrosine and tryptophan
(d) phenylalanine and methionine

Ans : **COMP 2011**

Hargobind Khorana first deciphered the triplet codon of cysteine and valine.
Thus (b) is correct option.

102. Experimental material in the study of DNA replication has been
(a) Escherichia coli
(b) Neurospora crassa
(c) Pneumococcus
(d) Drosophila melanogaster

Ans : **OD 2022**

Messelson and Stahl (1958) raised Escherichia coli on ammonium chloride having heavy isotope of nitrogen for several generations to study semi-conservative replication of DNA.
Thus (a) is correct option.

103. An octamer of 4 histones complexed with DNA forms
(a) endosome (b) nucleosome
(c) mesosome (d) centromere

Ans : **DELHI 2020**

Nucleosomes are oblate spherical structure having an octamer of four histone proteins (constituting 2 molecules of each type).
Thus (b) is correct option.

104. Genetic code consists of
(a) adenine and guanine
(b) cytosine and uracil
(c) cytosine and guanine
(d) all the above

Ans : **SQP 2021**

Genetic code is the relationship of amino acid sequence in a polypeptide chain and base sequence of mRNA. It includes adenine, guanine, cytosine and thymine.
Thus (d) is correct option.

105. Spliceosomes are not found in cells of;
(a) Fungi (b) Animals
(c) Bacteria (d) Plants

Ans : **OD 2009**

In eukaryotes spliceosomes are used in removal of introns during post-transcriptional processing of hnRNA. They are absent in prokaryotes.
Thus (c) is correct option.

106. Which of the following is required as inducer(s) for the expression of Lac operon?
(a) Glucose
(b) Galactose
(c) Lactose
(d) Lactose and galactose

Ans : **DELHI 2011**

Lac operon is an inducible operon. Lactose is the substrate for the enzyme beta-galactosidase and it also regulates switching on and off of the operon. Hence, it is termed as inducer. Inducers function by disabling repressor. The gene is expressed because an inducer binds to the repressor. The binding of the inducer to the repressor prevents the repressor from binding to the operator. RNA polymerase can then begin to transcribe operon genes.
Thus (c) is correct option.

107. Select the correct option:
Direction of RNA direction of reading of synthesis the template DNA strand
(a) $5' - 3'$ $3' - 5'$ (b) $3' - 5'$ $5' - 3'$
(c) $5' - 3'$ $5' - 3'$ (d) $3' - 5'$ $3' - 5'$

Ans : **FOREIGN 2018**

Synthesis of RNA exhibits several features that are synonymous with DNA replication. RNA synthesis requires accurate and efficient initiation elongation proceeds in the $5' \rightarrow 3'$ direction (i.e., the polymerase moves along the template strand of DNA in the $3' \rightarrow 5'$ direction), and RNA synthesis requires distinct and accurate

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containing lactose. Then the lac operon is induced.
Thus (c) is correct option.

125. An environmental agent, which triggers transcription from an operon is a
(a) regulator
(b) inducer
(c) depressor
(d) controlling element

Ans : **DELHI 2012**

The inducer is an environmental agent, which triggers transcription from an operon. The inducer of effector moelcule are small sized which can bind to a regular protein.
Thus (b) is correct option.

126. The lac operon is an example of
(a) arabinose operon
(b) inducible operon
(c) repressible operon
(d) overlapping genes

Ans : **SQP 2005**

The lac operon consists of a promotor gene, an oeprator gene and structural genes. There are three structural genes designated as z, y and a, which code for the enzymes β-galactosidase, lac permease and transacetylase respectively. It is an example of inducible operon.
Thus (b) is correct option.

127. In operon concept, regulator gene functions as
(a) repressor (b) regulator
(c) inhibitor (d) all of these

Ans : **SQP 2012**

Regulator gene produces a biochemical for suppressing the activity of the operator gene
Thus (a) is correct option.

128. In Escherichia coli, lac operon is induced by
(a) lactose (b) promoter gene
(c) β-galactosidase (d) I-gene

Ans : **SQP 2005**

Lac operon is an inducible operon system which regulates genetic material. The genetic material remains switched off normally but becomes operational in the presence of inducer lactose.
Thus (a) is correct option.

129. Binding of specific protein on reulatory DNA sequence can be studied by means of
(a) ultra centrifugation
(b) electron microscope
(c) light microscope
(d) X-ray crystallography

Ans : **FOREIGN 2007**

X-ray crystallagraphy is a technique to study the binding of specific protein on regulatory DNA. X-ray crystallography or single-crystal X-ray diffraction is an analytical technique which uses the diffraction pattern produced by bombarding a single crystal with X-rays to solve the crystal structure. The diffraction pattern is recorded and then analyzed or "solved" to reveal the nature of the crystal. This technique is widely used in chemistry and biochemistry to determine the structures of an immense variety of molecules, including inorganic compounds, DNA, and proteins.
Thus (d) is correct option.

130. Which of the following is not required for any of the techniques of DNA fingerprinting available at present?
(a) Polymerase chain reaction
(b) Zinc finger analysis
(c) Restriction enzymes
(d) DNA-DNA hybridization

Ans : **DELHI 2010**

Zinc-finger analysis is used for protein analysis. The zinc finger proteins are a super family or proteins involved in numerous activities of plant growth and development.
Thus (b) is correct option.

131. One of the most frequently used techniques in DNA fingerprinting is
(a) AFLP (b) VNTR
(c) SSCP (d) SCAR

Ans : **2009**

The technique of DNA fingerprinting was developed by Dr. alec Jeffrey in 1984. It is technique generally using repeated sequences (repetitive DNA) in the human genome that produces a patter n of band that is unique for every individuals. These short nucleotide repeats vary in number from person to person and are called variable number of tandem repeat (VNTR). VNTR belongs to class of setellite DNA referred to as minisatellite.
Thus (b) is correct option.

132. In history of biology human genome project led to the development of :
(a) biotechnology (b) biomonitoring
(c) bioinformatics (d) biosystematics

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Ans : **COMP 2011**

Reverse transcriptase (RNA dependent DNA polymerase) is present in some retroviruses eg. HIV virus.
Thus (c) is correct option.

116. What does "lac" refer to in what we call the lac operon?
(a) The number 1,00,000 (b) Lactose
(c) Lactase (d) Lac insect

Ans : **DELHI 2012**

Lactose operon in E. coli is a catabolic pathway in which the structural genes remain switched off unless the inducer (Lactose) is present in the medium.
Thus (b) is correct option.

117. During transcription, the DNA site at which RNA polymerase binds is called
(a) enhancer (b) promoter
(c) regulator (d) receptor

Ans : **FOREIGN 2008**

Regulator is a gene which form a biochemical for suppressing the activity of operator gene. Promoter is the gene which provides the point of attachment to RNA polymerase required for transcription of structural genes.
Thus (b) is correct option.

118. In E. coli during lactose metabolism repressor binds to
(a) regulator gene (b) operator gene
(c) structural gene (d) promoter gene

Ans : **OD 2007**

Regulator gene forms a biochemical for suppressing the activity of operator gene. Prometer gene is the gene which provides point of attachment to RNA polymerase required for transcription of structural genes. Structural genes are genes which transcribe m RNA for polypeptide synthesis.
Thus (b) is correct option.

119. Jacob and Monod studied lactose metabolism in E.coli and proposed operon concept. Operon concept is applicable for
(a) all prokaryotes
(b) all prokaryotes and some eukaryotes
(c) all prokaryotes and all eukaryotes
(d) all prokaryotes and some protozoans

Ans : **DELHI 2005**

Gene regulation of eukaryoes is complex as compared to that of prokaryotes.
Thus (b) is correct option.

120. In negative operon
(a) co-repressor binds with repressor.
(b) co-repressor does not bind with repressor.
(c) co-repressor binds with inducer.
(d) CAMP have negative effect on lac operon.

Ans : **COMP 2005**

In negative (repressible) operon, the repressor co-repressor complex binds with the operator. The free repressor cannot bind to the operator.
Thus (a) is correct option.

121. In which direction m-RNA is synthesised on DNA template?
(a) $5' \rightarrow 3'$ (b) $3' \rightarrow 5'$
(c) Both (a) and (b) (d) Any

Ans : **OD 2009**

The enzyme polymerase can synthesize the bases only in $5' \rightarrow 3'$ direction.
Thus (a) is correct option.

122. At time of organogensis genes regulate the process at different levels and at different time due to
(a) promoter (b) regulator
(c) intron (d) exon

Ans : **SQP 2005**

Intron are non coding intervening sequences on DNA but exons are the coding sequences.
Thus (b) is correct option.

123. The RNA that picks up specific amino acids from the amino acid pool in the cytoplasm to ribosome during protein synthesis is called
(a) mRNA (b) tRNA
(c) rRNA (d) carrier RNA

Ans : **FOREIGN 2015**

mRNA or messenger RNA brings coded information from DNA to form polypeptides. rRNA or ribosomal RNA occurs inside ribosomes and is involved in protein synthesis.
Thus (b) is correct option.

124. The wild type E. coli cells are growing in normal medium with glucose. They are transferred to a medium containing only lactose as sugar. Which of the following changes takes place?
(a) The lac operon is repressed
(b) All operons are induced
(c) The lac operon is induced
(d) E. coli cells stop dividing

Ans : **COMP 2006**

If Escherichia coli bacteria grow in normal glucose medium and when transferred to a medium

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translates in the form of peptide chain in the cytoplasm. It is also called central dogma.
Thus (a) is correct option.

138. **Assertion :** An organism with lethal mutation may not even develop beyond the zygote.
Reason : All types of gene mutations are lethal.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **SQP 2005**
Organisms with lethal mutation bear lethal genes that result in the death of the individual which carries them. The completely lethal genes usually cause death of the zygote. Mutation is a sudden heritable change in the sequence of gene occurring on the chromosomes. Mutation may be beneficial, normal, sublethal or lethal.
Thus (c) is correct option.

139. **Assertion :** Polytene chromosomes have a high amount of DNA.
Reason : Polytene chromosomes are formed by repeated replication.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **DELHI 2008**
Polytene chromosomes show endomitosis and they have high DNA content.
Thus (a) is correct option.

140. **Assertion :** DNA is associated with proteins.
Reason : DNA binds around histone proteins that form a pool and the entire structure is called a nucleosome.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **SQP 2005**
A chain of DNA has 140 base pairs, make $1\frac{3}{4}$ turns and twist around a histone octamer forming nucleosome. The core of nucleosome consists of 4 histones H_2A, H_2B, H_3 and H_4.
Thus (a) is correct option.

141. **Assertion :** The uptake of DNA during transformation is an active, energy requiring process.
Reason : Transformation occurs in only those bacteria, which possess the enzymatic machinery involved in the active uptake and recombination.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **FOREIGN 2012**
Transformation does not involve passive entry of DNA molecules through permeable cell walls and membranes. It does not occur 'naturally' in all species of bacteria, only in those species possessing the enzymatic machinery involved in the active uptake and recombination processes. Even in these species, all cells in a given population are not capable of active uptake of DNA. Only competent cells, which possess a so called competence factor are capable of serving as recipients in transformation.
Thus (a) is correct option.

142. **Assertion :** Replication and transcription occur in the nucleus but translation takes place in the cytoplasm.
Reason : mRNA is transferred from the nucleus into cytoplasm where ribosomes and amino acid are available for protein synthesis.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **OD 2013**
In eukaryotes, the replication and transcription takes place in the nucleus. mRNA comes out from the nucleus through the nuclear pore. In cytoplasm, translation occurs. In prokaryote,

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Ans : **COMP 2011**

Common activities in bioinformatics include mapping and analysing DNA and protein sequences, aligning different DNA etc. are the part of human genome project.
Thus (c) is correct option.

133. Satellite DNA is useful tool in
(a) organ transplantation
(b) sex determination
(c) forensic science
(d) genetic engineering

Ans : **OD 2017**

Satellite DNA is useful in forensic science. The polymorphism of minisatellite, microsatellite and minivariant repeats is analysed for DNA finger printing, DNA profiling. It helps in the resolution of crimes, legal disputes etc.
Thus (c) is correct option.

134. The basis for DNA fingerprinting is
(a) occurrence of restriction fragments length polymorphism (RFLP)
(b) phenotypic differences between individuals
(c) availability of cloned DNA
(d) knowledge of human karyotype

Ans : **SQP 2014**

DNA fingerprinting is a technique to identify a person on the basis of his DNA which is specific for every individual. This technique for the first time was developed by Alec Jeffreys and his colleagues at Leicester University in U.K. DNA of an individual carries specific sequences of nucleotides which are repeated many times througout the length of DNA. This reveals polymorphism in DNA. These are inherited. Each individual inherits these repeats from his/her parents which are used as genetic marker in personal identity test.
Thus (a) is correct option.

ASSERTION AND REASON

DIRECTION : Each of these questions contains as Assertion following by Reason. Read them carefully and answer the question on the basis of following options. You have to select the one that best describes the two statements.

135. Assertion : Histones are basic proteins of major importance in packaging of eukaryotic DNA. DNA and histones comprise chromain forming the bulk of eukaryotic chromosome.
Reason : Histones are of five major types H_1, H_2A, H_2B, H_3 and H_4.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **FOREIGN 2013**

Histones are basic proteins found in the eukaryotic chromosomes. These are rich in the amino acids lysine and arginine.

Histonie proteins are basic proteins consisting of 5 types - H_1, H_2A, H_2B, H_3, H_4. DNA is coiled around it. It exists as octamers linked with H_1.
Thus (a) is correct option.

136. Assertion : mRNA attaches to ribosome through its3' end.
Reason : The mRNA has F-capular nucleotide and bases of lagging sequence.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **OD 2006**

mRNA is attached to the ribosome by means of protein ribophorin I and II. The sequence of nucleotides on mRNA is called codon.
Thus (d) is correct option.

137. Assertion : Replication and transcription occur in the nucleus but translation in the cytoplasm.
Reason : m-RNA is transferred from the nucleus into the cytoplasm where ribosomes and amino acids are available for protein synthesis.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **COMP 2005**

DNA is the master copy which transcribes to form working copy in the form of mRNA which

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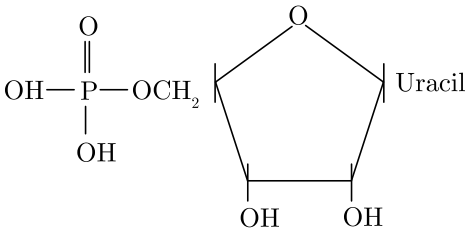
150. Identify the structure given below.



Ans :
The structure is a nucleotide called uridylic acid.

151. Name the specific components and the linkage between them that form deoxyadenosine.

Ans : **SQP 2005**
Adenine (N-glycosidic linkage) + Deoxyribose Deoxyadenosine.

152. Name the negatively charged and positively charged components of a nucleosome.

Ans : **OD 2012**
A histone octamer is the positively charged component and the DNA helix is the negatively charged component of nucleosome.

153. Name the two basic amino acids that provide positive charges to histone proteins.

Ans : **DELHI 2012**
Lysine and arginine.

154. Who proposed the nucleosome model? State the function of rRNA.

Ans : **DELHI 2016**
Roger Kornberg proposed nucleosome model rRNA plays structural and catalytic role during translation.

155. During DNA synthesis in bacteria, which enzyme is required?

Ans : **SQP 2020**
RNA-dependent DNA polymerase.

156. Name the transcriptionally active region of chromatin in nucleus.

Ans : **DELHI 2015**
Euchromatin.

157. What will happen if DNA replication is not followed by cell division in a eukaryotic cell?

Ans : **All India 2014**
If cell division is not followed after DNA replication then replicated chromosomes (DNA) would not be distributed to daughter nuclei. A repeated replication of DNA without any cell division results in the accumulation of DNA inside the cell. This would increase the volume of the cell nucleus, thereby causing cell expansion.

158. What conclusion was drawn from the blender experiment performed by Hershey and Chase?

Ans : **COMP 2010**
The conclusion drawn was that the genetic material that is passed from virus to bacteria mentioned in transforming principle, was DNA not proteins.

159. Why is RNA more reactive in comparison to DNA?

Ans : **DELHI 2015**
The OH-bond in the ribose of RNA makes the molecule more reactive, compared with DNA. RNA is not stable under alkaline conditions.

160. Why is it not possible for an alien DNA to become part of chromosome anywhere along its length and replicate normally?

Ans : **All India 2014**
An alien DNA cannot become a part of chromosome any where along its length and replicate normally, due to the absence of origin of replication where the replication process is initiated.

161. Name the enzyme and state its property that is responsible for continuous and discontinuous replication of the two strands of a DNA molecule.

Ans : **DELHI 2013**
DNA-dependent DNA polymerase. This enzyme can polymerise deoxynucleotides in $5' \rightarrow 3'$ direction only. Due to this, replication of DNA is continuous in one strand $3' \rightarrow 5'$ while discontinuous in another $5' \rightarrow 3'$

162. Name the enzyme involved in continuous replication of DNA strand. Mention the polarity of the template strand.

Ans : **All India 2012**
Enzyme involved in continuous replication of DNA strand is DNA polymerase.
Template strand has 3'-45' polarity.

163. What is a cistron?

Ans : **All India 2015**
A segment of DNA that codes for a polypeptide.

164. Which one out of an intron and an exon is the reminiscent of antiquity?

Ans : **All India 2013**
Intron is considered to be the reminiscent of antiquity.

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there is no nuclear membrane, so replication, transcription and translation all occur in the cytoplasm.
Thus (a) is correct option.

143. **Assertion :** UAA, UAG and UGA terminate protein synthesis.
Reason : They are not recognised by tRNA
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : SQP 2015
Synthesis of polypeptide terminates when a nonsence codon of mRNA reaches the A-site. There are three nonsense codons- UAA, UAG and UGA. These codons are not recognised by any of the *t*RNAs. Therefore, no more aminoacyl *t*RNA reaches the A site. The P-site *t*RNA is hydrolysed and the completed polypeptide is released in the presence of a release factor.
Thus (a) is correct option.

144. **Assertion :** In a DNA molecule, A-T rich parts melt before G-C rich parts.
Reason : In between A and T there are three H-bond, whereas in between G and C there are two H-bonds.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : COMP 2017
In a DNA molecule, A-T rich parts melt before G-C rich parts because there are two H-bond between A and T whereas in between G and C, there are three H-bond.
Thus (c) is correct option.

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VERY SHORT ANSWER QUESTIONS

145. What is teminism?

Ans : SQP 2005
Reverse transcription is known as teminism, which was first reported by Temin and Baltimore. RNA of some viruses (Retroviruses) first synthesises DNA through reverse transcription. The DNA then transfers information to RNA, which takes part in translation of coded information to form polypeptide.

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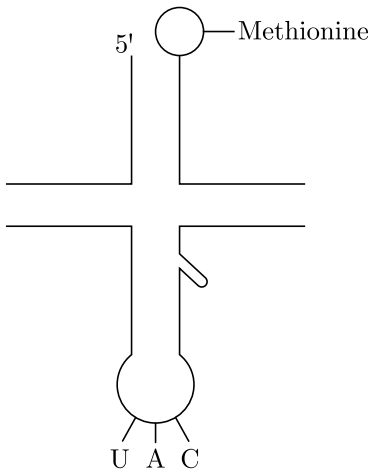
146. What do you understand by UTR? Mention its role in translation.

Ans : DELHI 2013
An mRNA has some additional translation which are not coded, these are referred as untranslated regions (UTRs). The UTRs are present at both 5′ end (before start codon) and at 3′ end (after stop codon). They are required for efficient translation process.

147. Draw the structure of the initiator tRNA adaptor molecule.

Ans : SQP 2017



148. Why is tRNA called an adaptor molecule?

Ans : FOREIGN 2008
tRNA is called an adaptor molecule because
(a) On one hand it reads the code
(b) On the other hand it binds to specific amino acid.

149. Group the following as nitrogenous bases and nucleosides.
Adenine, guanosine, cytosine, cytidine, thymine, uracil

Ans : OD 2015
Nitrogenous bases are adenine, cytosine, thymine and uracil. Nucleosides are guanosine and cytidine.

90. In eukaryotes, after transcription of mRNA, some of its nucleotides are removed before it is translated into polypeptide. The nucleotides which are removed from mRNA are called
(a) exons
(b) upstream sequences
(c) unusual bases
(d) introns

Ans : FOREIGN 2014

Replication of DNA is discontinuous over the lagging strand over which only small stretches of DNA are built due to opposite running of DNA template the small stretches of DNA are called okazaki fragments.
Thus (d) is correct option.

91. Okazaki fragments are seen during
(a) transcription (b) translation
(c) replication (d) transduction

Ans : OD 2018

Replication of DNA is discontinuous over the lagging strand over which only small stretches of DNA are built due to opposite running of DNA template. The small stretches of DNA are called okazaki fragments.
Thus (c) is correct option.

92. In split genes, the coding sequences are called
(a) introns (b) operons
(c) exons (d) cistrons

Ans : DELHI 2012

The region of a gene which becomes part of m-RNA and code for different regions of the proteins are called exons.
Thus (c) is correct option.

93. Protein helping in opeining of DNA double helix in form of replication fork is
(a) DNA gyrase
(b) DNA plymerase I
(c) DNA ligase
(d) DNA topoisomerase

Ans : COMP 2005

DNA gyrase participates in the unwinding of DNA helix during replication.
Thus (a) is correct option.

94. Which is not involved in protein synthesis?
(a) Transcriptioin (b) Initition
(c) Elogation (d) Termination

Ans : FOREIGN 2015

Protein synthesis stops when a nonsense codon (UAA, UGA or UAG) reaches the amino acyl or A site.
Thus (d) is correct option.

95. Reverse transcriptase is
(a) RNA dependent RNA polymerase
(b) DNA dependent RNA polymerase
(c) DNA dependent DNA polymerase
(d) RNA dependent DNA polymerase

Ans : SQP 2005

The phenomenon of making DNA over RNA genome through enzyme reverse transcriptase is called reverse transcription of feminism.
Thus (d) is correct option.

96. The number of base substitution possible in amino acid codon is
(a) 261 (b) 264
(c) 535 (d) 549

Ans : FOREIGN 2016

Codons are 6 in number. Each codon posses 3 bases, each of which can undergo transition and transversion. $(1 \times 3^2 = 549)$
Thus (d) is correct option.

97. During DNA replication, the strands separate by
(a) DNA polyemrase (b) topisomerase
(c) unwindase/Helicase (d) gyrase

Ans : OD 2012

Unwindase or helicase takes part in separation of two DNA strands. In prokaryotes, helicase or unwindase is assisted by gyrase in this function.
Thus (c) is correct option.

98. Out of A-T, G-C pairing, bases of DNA may exist in alternate valency state owing to arrangement called
(a) analogue substitution
(b) tautomerisational mutation
(c) frame-shift mutation
(d) point mutation

Ans : SQP 2009

The tautomer forms of nitrogen bases are immuno-tautomer instead of amino group (e.g. cytosine, adenine) or enol instead of the keto group (e.g. thymine, guanine).

Tautomers are organic compounds that are interconvertible by a chemical reaction called tautomerization. The concept of tautomers that are interconvertible by tautomerizations is called tautomerism. Tautomerism is a special case of structural isomerism and can play an important

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165. Where does transcription and translation occur in bacteria inacteria and eukaryotes, respectively?

Ans : **FOREIGN 2005**

In bacteria, both transcription and translation processes occur in the cytoplasm as there is no nucleus.

In eukaryotes, transcription occurs in nucleus, while translation occurs in the cytoplasm.

166. Which one out of rho factor and sigma factor act as an initiation factor during transcription in a prokaryote?

Ans : **DELHI 2013**

Sigma factor acts as an initiation factor and binds to the promoter during transcription in prokaryotes.

167. Why does hnRNA undergo splicing? Where does splicing occur in the cell?

Ans : **DELHI 2015C, 2009**

hnRNA undergoes splicing to remove introns and join exons. Splicing occurs in the nucleus of the cell.

168. Name the enzyme that transcribes hnRNA in eukaryotes.

Ans : **DELHI 2015**

The RNA polymerase-II transcribes the precursor of mRNA, the heterogeneous nuclear RNA (hnRNA).

169. Give an example of codon having dual function.

Ans : **All India 2016**

AUG codes for amino acid methionine (met) and also acts as an initiation codon.

170. All terminater codons begin with nucleotide of which base?

Ans : **FOREIGN 2005**

Uracil 'IJ'.

171. Due to an error during transcription, ATG of DNA formed UAG in mRNA.

What would happen to the polypeptide chain during translation due to this changed mRNA?

Ans : **COMP 2015**

Polypeptide chain synthesis will stop as UAG is stop codon.

172. Mention the role of the codons AUG and LIGA during protein synthesis.

Ans : **DELHI 2011**

AUG Acts as initiation codon and codes for amino acid methionine.

UGA Acts as stop or termination codon.

173. Which codon is known as an ochre?

Ans : **OD 2024, 2006**

UAG

174. Name the antibiotic that inhibits binding of amino-acyl tRNA to ribosomes.

Ans : **DELHI 2012**

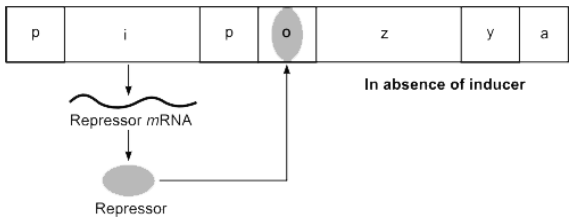
Tetracyclin

175. Why were protein discarded from being the genetic material?

Ans : **OD 2002**

Proteins are not able to replicate itself.

176. Given below is a schematic representation of a lac operon in the absence of an inducer. Identify A and B in it.



Ans : **FOREIGN 2008**

A - Repressor protein.

B - Repressor bound to the operator it prevents transcription of structural genes.

177. Who discovered DNA as genetic material?

Ans : **SQP 2016**

Hershey and Chase.

178. Why does the distance between the two polynucleotide strands of DNA remain almost constant?

Ans : **FOREIGN 2012**

In a DNA molecule, a large sized purine (A, G) always comes opposite and pairs with pyrimidines (T, C). This generates a uniform distance between the two strands of a DNA helix.

179. What is the base pairing pattern of DNA?

Ans : **FOREIGN 2005**

Guanine pair with cytosine and adenine pair with thymine.

180. Name the strand which undergoes discontinuous replication.

Ans : **DELHI 2012**

Lagging strand $(3'\,5')$.

181. Which one is removed during splicing-introns or exons?

Ans : **COMP 2013**

Introns.

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182. Name the property of DNA that governs transcription.

Ans : OD 2023

Principle of complementarity

183. Which was the last human chromosome to be completely sequenced?

Ans : DELHI 2021

Chromosome -1.

SHORT ANSWER QUESTIONS

184. Describe the two salient features of double Helix structure of DNA.

Ans : OD 2018

The two main features of double helix structure of DNA are as follows.

(i) It is composed of two right handed helical poly-nucleotide chain that form a double helix around the same central axis. This poly-nucleotide chain is composed of deoxy ribose sugar and a phosphate linked together by phosphodiester bond.

(ii) The two poly-nucleotide chains are anti parallel to each other and are held together by hydrogen bonds between nitrogenous bases.

185. Name any two (2) enzymes of DNA replication and mention one specific function of each of them.

Ans : COMP 2018

The process of DNA replication involves participation of several classes of highly committed enzymes like nuclease, polymerases, primases and ligases.

(i) **DNA polymerase :** These enzymes are responsible for the synthesis of new DNA strands. These DNA polymerases cannot initiate DNA synthesis. It is capable of adding nucleotides to the 3' hydroxyl end of an existing strand. They specifically need a primer to provide 3' OH terminus to the enzyme to initiate synthesis of new DNA Strand.

(ii) **DNA topoisomerase :** These class of enzyme can effectively alter the shape of the DNA by introducing supercooling in them.

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186. Explain the structure of DNA.

Ans : OD 2017

DNA is a long polymer of deoxyribonucleotides. Each DNA nucleotide is made up of deoxyribose sugar, a phosphate group and a nitrogenous base. Watson and Crick first described the structure of DNA double helix in 1953 using X ray diffraction data produced by R.Franklin and M. wilkins. According to this model

(i) DNA is made up of two long polynuclotide chains coiled around a central axis in right handed helix, that runs anti paralled to each other.

(ii) The backbone of the polynucleotide chain is made of sugar and phosplate linked together by phosphodiester bond, while nitrogenous bases are projected inwards.

(iii) These two DNA strands are held together by weak hydrogen bonds between the nitrogenous bases along the entire length of DNA molecule. ($A = T$, $G \equiv C$)

(iv) The twisting of strands results into formation of major and minor groove. A complete turn measures 34 Å with the distance of 3.4 Å between two successive base pairs. (Thus, there are 10 base pair per turn).

187. Differentiate between nucleoside and nucleotide.

Ans : OD 2016, SQP 2012

Difference between nucleoside and nucleotide are as follows :

	Nucleoside	**Nucleotide**
(i)	It is made of nitrogenous base and phosphate group only.	It is composed of nitrogenous base, sugar and phosphate group.
(ii)	It is a precursor of nucleotide.	It is a precursor of DNA or RNA polynucleotide.
(iii)	Slightly basic in nature.	Acidic in nature.
(iv)	**Example :** Adenine = Adenine + Ribose sugar.	**Example :** Adenylic Acid = Adenosine + Phosphoric acid.

188. Differentiate between DNA and RNA.

Ans : OD 2015, FOREIGN 2011

Difference between DNA and RNA are as follows :

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DNA	RNA
It is double stranded nucleic acid.	It is single stranded nucleic acid.
It contains deoxyri bose sugar.	It contains ribose sugar.
It contains Thymine (T) as a nitrogenous base.	It contains Uracil (U) instead of Thymine.
It is the genetic and hereditary material of the cells.	It is involved in synthesis of proteins.
It is present in the nucleus of the cells.	It is present in both nucleus and cytoplasm.

189. Distinguish between transcription and translation?

Ans : **OD 2010**

Transcription : Transcription is a process in which formation of ribonucleic acid (RNA) takes place from DNA template strand. The principle of complementarity governs the process of transcription (except of ademine that pairs with uracil instead of thymine).The enzymes responsible for transcription in both prokaryotic and enkaryotic cells are calles DNA-dependent RNA polymerases.

Translation : Translation is the process in which formation of protein takes place from RNA strand here genetic information present in mRNA directs the order of specific amino acid to form a polypeptide chaim.

190. Which property of DNA double helix led Watson and Crick to hypothesise semiconservative mode of DNA replication? Explain

Ans : **COMP 2015**

The Watson and Crick observed that the nitrogenous bases form complementary pair between the two polynucleotide chains of DNA. Based on the X-ray diffraction data, they proposed that DNA consisted of a double helix with two chains having sugar phosphate on the outside and nitrogen bases on the inner side.

Further, they proposed that the two chains are antiparallel with $5' - 3'$ orientation of the other. The two chains are twisted helically just as a rope ladder with rigid steps twisted into a spiral.

This property of double helix model of DNA led them to hypothesize semiconservative mode of DNA replication, where the two strands separate and act as a template for the synthesis of new complementary strand.

191. Depending upon the chemical nature of template (DNA or RNA) and the nature of nucleic acids synthesised from it (DNA or RNA), list the types of nucleic acid polymerases.

Ans : **OD 2019**

(i) DNA-dependent DNA polymerase. Uses DNA template to catalyze the polymerisation deoxynucleotides.

(ii) DNA-dependent RNA polymerase. Catalyzes transcription of all types of RNA (in bacteria).

(iii) DNA dependent RNA polymerase-I transcribes rRNAs.

(iv) DNA dependent RNA polymerase-II transcribes precursor of mRNA (hnRNA)

(v) DNA dependent RNA polymerase-III transcribes tRNA. The last three polymerases are in eukaryotes.

192. Differentiate between the followings :

(i) Rpetitive DNA and Satellite DNA

(ii) mRNA and tRNA

(iii) Template strand and Coding strand

Ans : **DELHI**

(i) Satellite DNA consists of highly repetitive DNA and is so called because repetitions of a short DNA sequence tend to produce a different frequency of the nucleotides adenine, cytosine, guanine and thymine, and thus have a different density from bulk DNA-such that they form a second or 'satellite' and when genomic DNA is separated on a density gradient.

(ii) Messenger RNA transfers the code or instructions to produce certain type of proteins. Transcription RNA decodes these codes at the site of protein synthesis.

(iii) The coding strand is the DNA strand which has the same base sequence as the RNA transcript produced (although with thymine replaced by uracil). It is this strand which contains codons, while the non-coding strand contains anti codons. The strand containing codon is called template strand and provides a template based on which new RNA is made.

193. List two essential roles for ribosome during translation.

Ans : **OD 2011**

Two essential sole for ribosome during translation are as follows:

(i) When the small sub-unit of ribosome encounters and mRNA, the process of translation of the mRNA to protein begins.

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(v) Improve tools for data analysis.

(vi) Find out possibilities of transfer of technology developed during HGP to industry.

(vii) Address ethical, legal, and social issues (ELSI) that may arise from the project.

207. Three codons on mRNA are not recognised by transfer RNA. What are they? What is the general term used for them? What is their significance in protein synthesis?

Ans : **DELHI 2006**

These codons are UAA, UAG and UGA. The general name given to these codons is nonsense codons.

These codons do not specify any amino acid but the termination of polypeptide chain is signalled by them.

208. What are the functions of DNA polymerase?

Ans : **SQP 2012**

(i) DNA polymerase uses a DNA template to catalyse the polymerisation of deoxynucleotides during the process of DNA replication.

(ii) RNA primer is removed from the 5′ end by the exonuclease activity of DNA polymerase.

(iii) DNA polymerase is also involved in proof-reading and DNA repair. The wrongly introduced bases can be removed by the activity of this enzyme

209. Write the full form of VNTR? How is the VNTR different from 'probe'?

Ans : **FOREIGN 2005**

Variable Number Tandem Repeats (VNTR)

VNTRs are the short nucleotide repeats in the DNA which are very specific in each individual and vary in number from person to person but are inherited whereas DNA probes are made in the laboratory which contains repeated sequences of bases complementary to those on VNTRs. DNA probes are made radioactive by labelling with radioactive isotopes.

210. Why is it essential that tRNA binds to both an amino acid and an mRNA codon during protein synthesis?

Ans : **DELHI 2010**

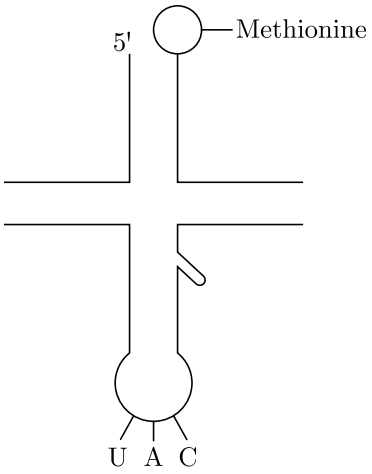
tRNA is an adaptro molecule, which is meant for transferring amino acids to ribosomes for synthesis of polypeptides. tRNA carry specific amino acids at particular points during polypeptide synthesis as per codons of mRNA, and the codons are recognised by anticodons of tRNAs.

Thus, the coded information from DNA is translated by bringing amino acids in a particular sequence.

211. One of the codons on mRNA is AUG. Draw the structure of tRNA adaptor molecule for this codon. Explain the uniqueness of this tRNA.

Ans : **FOREIGN 2012**

This tRNA is specific for methionine. It acts as initiator tRNA.



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212. The length of a DNA molecule in a typical mammalian cell is calculated to be approximately 2.2 metres. How is the packaging of this long molecule done to accumulate it within the nucleus of the cell?

Ans : **COMP 2006**

Positively charged histone proteins are organised to form histone octamer (unit of eight molecules), negatively charged DNA is wrapped around the octamer, nucleosomes contain 200 bp of DNA helix formed, Repeating units of nucleosomes constitute chromatin fibres, further coiling forms chromosome, using non histone chromosomal proteins.

213. Explain the dual function of AUG codon. Give the sequence of bases it is transcribed from and its anticodon.

Ans : **OD 2011**

(i) AUG is the initiation codon in protein synthesis

(ii) AUG codes for amino acid, methionine
(a) It is transcribed from TAC of DNA
(b) Its anticodon is UAC

214. (i) In human genome which one of the chromosomes has the most genes and which one has the fewest?

202. Differentiate between euchromatin and heterochromatin.

Ans : DELHI 2007

The difference euchromatin and heterochromatin are as follows :

	Euchromatin	Heterochromatin
(i)	In a nucleus, some regions of chromatin are loosely packed and stain light. These are reffered to as euchromatin.	The chromatin that is more densely packed and strain dark are called heterchromatin.
(ii)	Itistranscriptionally active chromatin.	Heterochromatin is inactive.

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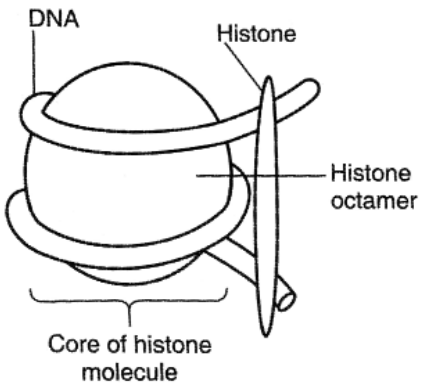
203. How is a nucleosome formed? Draw the diagram of a nuclesome

Ans : FOREIGN 2009

DNA pacing in eukaryotes is carried out with the help of lysine and argenine rich basic protein called histones. The unit of compaction is nucleosome.

(i) Histones are organised to form a unit of eight molecules called histone octamer.

(ii) The negatively charged DNA is wrapped around the positively charged histone octamer, form a structure called nucleosome.



204. Differentiate between leading strand and lagging strand.

Ans : SQP 2010

The difference between leading strand and lagging strand are as follows :

	Leading strand	Lagging strand
(i)	It is a replicated strand of DNA which grows continuously without any gap.	The lagging strand is a replicated strand of DNA which is formed in short segments called discontinuous.
(ii)	It does not required DNA ligase for its growth.	DNA ligase is required for joining okazaki fragments.
(iii)	The direction of growth of a leading strand is $5' \rightarrow 3'$.	The direction of the lagging strand is $3' \rightarrow 5'$.
(iv)	Only a single RNA primer is required.	Starting of each okazaki fragment requires a new RNA.
(v)	Its template opens in $3' \rightarrow 5'$ direction.	Its template opens in $5' \rightarrow 3'$ direction.
(vi)	Formation of leading strand begins immediately at the beginning of replication.	Formation of lagging strand begins a bit later than that of leading strand.

205. Why RNA is not a suitable genetic material in comparison with DNA? Explain.

Ans : COMP 2013

(i) RNA functions as an enzyme and is therefore reactive and unstable.

(ii) Uracil present in the RNA is less stable as compared to thymine of DNA.

(iii) Being unstable RNA mutates at a much faster rate, that is why RNA viruses have shorter life span and mutate and evolve very fast. Such rapid changes are harmful to higher forms of life.

206. Enumerate the goals of human genome project.

Ans : OD 2009

The goals of HGP are as follows:

(i) Determine the sequence and number of all the base pairs (three billion) in the human genone.

(ii) Identify all the genes (25000) present in human DNA.

(iii) Determine the function of all the genes ad identify the various genes that cause genetic disorders.

(iv) Store the information in data bases.

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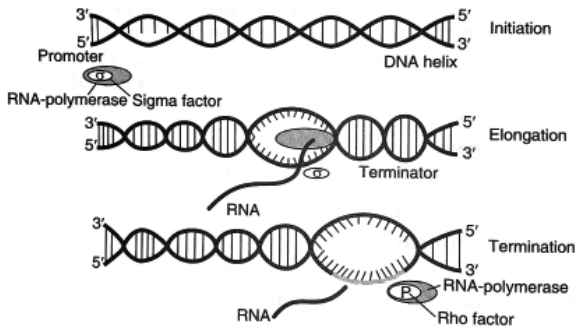
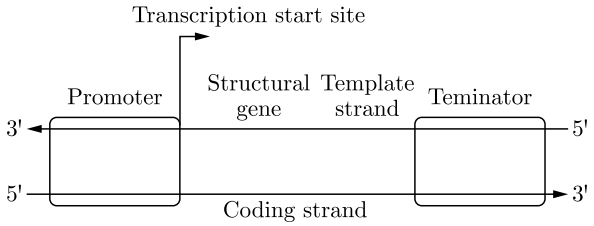
219. Illustrate schematically the process of initiation, elongation and termination during transcription of a gene in a bacterium.

Ans : **COMP 2020**



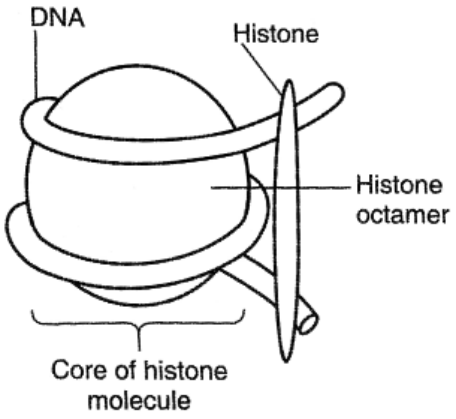
220. Draw a labelled schematic diagram of a transcription unit.

Ans : **SQP 2009**



221. Draw a labelled diagram of a nucleosome. Where is it found in a cell?

Ans : **FOREIGN 2012**



It is found in the nucleus.

222. Why is DNA considered a better hereditary material than RNA?

Ans : **FOREIGN 2005**

(i) Presence of thymine in DNA instead of uracil provides additional stability to DNA.

(ii) DNA is chemically less reactive and structurally more stable.

(iii) RNA behaves as a catalyst due to 2′-OH group of ribonucleotides which is a reactive group.

(iv) RNA being unstable, mutate at a faster rate.

223. State the condition when genetic code is said to be:

(i) Degenerate

(ii) Unambiguous and specific

(iii) Universal

Ans : **DELHI 2009**

(i) Some amino acids are coded by more than one codon hence the code is degenerate.

(ii) One codon codes for only one amino acid hence it is unambiguous and specific.

(iii) The codon codes for same amino acid in any organism from bacteria to human i.e., universal.

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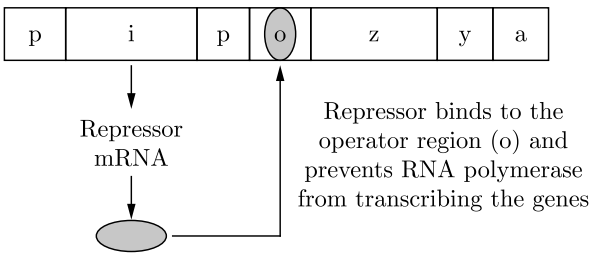
224. Look at the figure below depicting lac operon of *E*. coli.



(i) What could be the series of events when an inducer is present in the medium in which *E* .coli is growing?

(ii) Name the Inducer.

Ans : **COMP 2016**

(i) When the inducer is present, it combines with the repressor,coded by *i* gene.

After reacting with repressor it inactivates the repressor.

The repressor now cannot bind to the operator, hence the pathway for RNA polymerase is open.

The structural genes (z, y, a) are transcribed and the metabolism continues.

(ii) Lactose is inducer.

225. One chromosome contains one molecule of DNA. In eukaryotes the length of the DNA molecule is enormously large. Explain how such a long molecule fits into the tiny chromosomes seen at metaphase.

(ii) Scientists have identified about 1.4 million single nucleotide polymorphs in human genome. How is the information of their existence going to help the scientists?

Ans : **FOREIGN 2005**

(i) Chromosome NO. 1 has the most gene *Y* -chromosome has the fewest genes

(ii) The information of SNPs is expected to help in-

(a) Locating the disease-associated sequences of DNA on the chromosomes

(b) Tracing human history

215. What are satellite DNA in a genome? Explain their role in DNA fingerprinting.

Ans : **SQP 2012**

(i) Satellite DNA refers to the bulk of the genomic DNA, whose sequences do not code for proteins, but forms major peaks during density gradient centrifugation. It is of 2 types

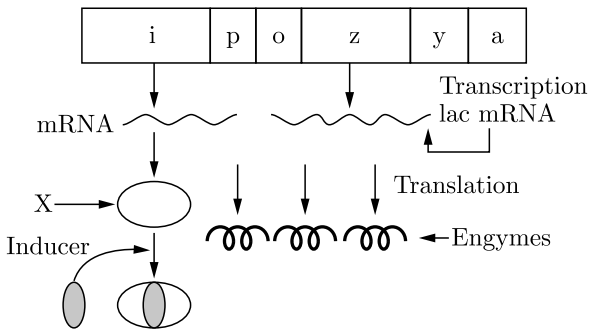
(a) Microsatellite DNA

(b) Mini-satellite DNA

(ii) The sequence of satellite DNA show high degree of polymorphism.

(iii) Since DNA from every tissue of an individual shows the same degree of polymorphism, it forms the basis of DNA fingerprinting. Since the polymorphism is also inherited by children from the parents, it helps in paternity testing in dispute cases.

216.



(i) Name the molecule '*X*′ synthesised by '*i*′ gene. How does this moelcule get inactivated?

(ii) Which one of the structural genes codes for β -galactosidase?

(iii) when will teh transcription of this gene stop?

Ans : **DELHI 2011**

(i) *X* is a repressor protein; when an inducer (lactose) combines with it, it is inactivated.

(ii) *z* gene codes for β-galactosidase.

(iii) The transcription of this gene would stop when repressor protein binds to operator gene; thus preventing RNA polymerase from transcribing operon in the absence of an inducer.

217. A tRNA is charged with amino acid methionine

(i) Name the process involved in the attachment

(ii) Point out the mRNA codon and anticodon on tRNA for this amino acid.

(iii) What is heterochromatin?

Ans : **OD 2007**

(i) Initiation

(ii) mRNA codon = AUG

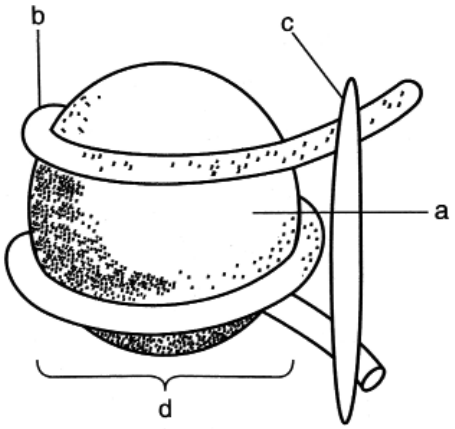
tRNA anticodon = UAC

(iii) The densely packed and dark stained/ transcriptionally inactive chromatin is known as the heterochromatin.

218. (i) What is this diagram representing?

(ii) Name is the parts *a*, *b* and *c*.

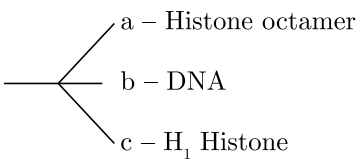
(iii) In the eukaryotes the DNA moleules are organised within the nucleus. How is the DNA molecule organised in a bacterial cell in absence of a nucleus?



Ans : **FOREIGN 2015**

(i) Nucleosome

(ii)



(iii) In prokaryotes, the DNA is helf with some positively changed proteins to form a nucleoid. The DNA is then organised as large loops held by the proteins.

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(vi) **The code is Redundant :** In most of the cases several codons code for the same amino acid e.g. one amino acid Isoleucine is coded by three codons

This multiple system of coding is known as degenerate or redundant code system. Such system provides a protection to the organism against many harmful mutations, because if one base of a codon is mutated, there are other codons which will code for the same amino acid and there will be no alteration in the polypeptide chain.

(vii) **The Code Has polarity :** The code has a definite direction for reading of message, which is referred to as polarity.

228. Define linkage and linkage group. Discuss the effect of linkage and its importance.

Ans : **OD 2015**

When two or more characters of parents are transmitted to the offsprings of few generations such as F_1, F_2, F_3 etc. without any recombination, they are called as the linked characters and the phenomenon is called as linkage. It describes the way in which two genes that are located close to each other on a chromosome are often inherited together. It is an example of deviation from the Mendelian principle of independent assortment.

Linkage Groups : A linkage group is a linearly arranged group of linked genes which are normally inherited together except for crossing over. It corresponds to a chromosome which bears a linear sequence of genes linked and inherited together. Because the two homologous chromosomes possess either similar or allelic genes on the same loci, they constitute the same linkage group. Therefore, the number of linkage groups present in an individual corresponds to number of chromosome in its one genome (all the chromosomes if haploid or homologous pairs if diploid). It is known as principle of limitation of linkage groups.

The size of the linkage group depends upon the size of the chromosome. The smaller chromosome will naturally have smaller linkage group while a longer one has longer linkage group.

Importance of linkage :

(i) Linkage plays an important role in determining the nature of scope of hybridization and selection programmes.

(ii) Linkage reduces the chance of recombination of genes and thus helps to hold parental characteristics together. It thus helps organism to maintain its parental, racial and other characters. For this reason plant and animal breeders find it difficult to combine various characters.

229. Write the following in brief:

(i) Types of RNA (ii) Transcription

(iii) Translation

Ans : **OD 2014**

(i) **Types of RNA :** Ribose nucleic acid (RNA) is polymer of ribose nucledes, which are made up of pentose ribosome sugar, phosphoric acid and nitrogenous bases (A, G,C and U). On the basis of molecular size and function three types of RNA have been recognised.

(a) **Ribosomal RNA** (rRNA) **:** It is found in the highest amount in cells (approx 60%). It is made of long polynucleotide chain. It mainly participates in the formation of ribosome.

(b) **Transfer RNA** (rRNA) **:** It is soluble in 1M NaCl solution. Therefore, it is also called soluble RNA (rRNA). In the total amount of cellular RNA, its part is about 15%. It helps in translation process of protein synthesis and it is made up of 75-90 nucleotides.

(c) **Messenger RNA (mRNA) :** This type of RNA molecule carries a portion of the DNA code to other parts of the cell for processing mRNA is created during transcription process.

(ii) **Transcription :** Transcription is a process in which formation of ribonucleic acid (RNA) takes place from DNA template stand. The principal of complementarity governs the process of transcription (except of adenine that pairs with uracil instead of thymine). The enzymes responsible for transcription in both prokareyotic and eukaryotic cells are called DNA-dependent RNA polymerases. The segment of DNA that take part in transcription is called transcription unit. It is made up of three pats; a promoter, structural gene (coding gene) and terminator. The main steps of transcription are as follows.

(a) Binding of RNA polymerase with its sigma factor to DNA strand.

(b) Initiation of transcription by attachment of RNA polymerase to initiation site followed by uncoiling of DNA strands and formation of nascent RNA strand.

(c) Elongation of RNA strand by further addition of ribonucleotides.

(d) Termination of transcription process by binding of Rho factor and release of RNA

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Ans : **OD 2011**

In eukaryotes, there are certain positively charged, basic proteins, called histone. They are rich in basic amino acid residues, lysines and arginines. Histones are organised to form a unit of eight molecules, called a histone octamer.

The negatively charged DNA is wrapped around the positively charged histone octamer, to form nucleosome. A typical nuclesome contains 200 bp of DNA helix. Nucleosomes constitute the repeating units of chromatin which are thread like stained bodies. The nucleosomes are seen as 'beads-on-string structures' under an electron microscope.

Such beads-on-string structure is packaged to form chromatin fibres, that are further coiled and condensed at metaphase stage of cell division, to form chromosomes.

The packaging of chromatin at higher level requires additional set of proteins called non-histone chromosomal (NHC) proteins

226. Mention the role of ribosomes in peptide-bond formation. How does ATP facilitate it?

Ans : **SQP 2015**

Ribosomes provide the site for the binding of amino acid. They acts as a catalyst (23Sr RNA) for peptide bond formation.

Role of ATP. Amino acids are activated by ATP and linked to the tRNA by the process aminoacylation or charging of tRNA. Peptide bond always form between two activated amino acids.

LONG ANSWER QUESTIONS

227. What do you understand by Genetic code? Describe the types and characteristics of genetic code in detail.

Or

Explain properties of genetic code

Ans : **OD 2016, FOREIGN 2014**

Genetic code is the relationship between the sequence of bases in nucleic acid and the order of amino acids in the polypeptide synthesised from it. A sequence of three nucleic acid bases acts as a codeword (codon) for one amino acid.

Types of Genetic Code : The genetic code can be expressed as either RNA codons or DNA codons. RNA codons occur in messenger RNA (mRNA) and are the codons that are actually "read" during translation Each mRNA molecule acquires its sequence of nucleotides by transcription from the corresponding gene [DNA].

DNA codons are of two types

(i) **Sense codons :** These are the codons that code for amino acids are called sense codons. There are 61 sense codons in the genetic code which code for 20 amino acids.

(ii) **Signal codons :** These are the codons that code for signals during protein synthesis are known as signal codons. There are four codons which code for signal. These are AUG, UAA, UAG and UGA. They are of two types.

(a) **Start Codons :** The codon which starts the translation process is known as start codon. It is also known as initiation codon. Example of this codon is AUG.

(b) **Stop Codons :** These codons are also known as termination codons because they provide signal for the termination and release of polypeptide chain. Examples of stop codons are UAA, UAG and UGA.

Characteristics of Genetic code :

(i) **The code is Triplet :** The genetic code is triplet. It has 64 codons which are sufficient to code for 20 amino acids and also for start and stop signals in the synthesis of polypeptide chain.

(ii) **The code is Universal :** The genetic code is almost universal. The same codons are assigned to the same amino acid and to the same START and STOP signals in the vast majority of genes in animals, plants, and micro organisms.

(iii) **The Code is Comma-less :** It means that they are continuous and there are no demarcation lines between codons. Deletion of a single base in a comma-less code alters the entire sequence of amino acids after the point of deletion.

(iv) **The Code is Non-Overlapping :** Three nucleotides or bases code for one amino acid. In a non-overlapping code, six bases will code for two amino acids. In a non-overlapping code, one latter is read only once. In overlapping code, six nucleotides or bases will code for 4 amino acids, because each base is read three times.

Example : There are Bases : CATGAT

Non-overlapping Code : 2 that is CAT and GAT

Overlapping Code : 4 that is CAT, GAT, ATG and TAT

(v) **The Code is Non-ambiguous :** The genetic code has 64 codons. Out of these, 61 codons code for 20 different amino acids. Each codon codes only for one amino acid Which indicates that the genetic code is non-ambiguous.

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(ii) Ribosome also acts as catalyst (23 SrRNA in bacteria is the enzyme ribozyme) for the formation of peptide bond.

194. In the medium where *E*.coli was growing, lactose was added, which induced the lac operon. Then why does lac operon shut down after sometime after addition of lactose in the medium?

Ans : **COMP 2013**

Lac operon is shut down after some times when the added lactose is utilised from the medium. It is because the repressor protein binds to the operator regions of the operon and prevent RNA polymerase from transcribing the operon.

195. Briefly describe the following

(i) Transcription

(ii) Polymorphism

(iii) Translation

(iv) Bioinformatics

Ans : **SQP 2010**

(i) Transcription is the process of creating a RNA copy of a DNA sequence.

(ii) When different types of phenotype occur in the same species the situation is called polymorphism.

(iii) Translation is the process of creating protein once the genetic code has been decoded by transcription.

(iv) Bionformatics is the fusion of information technology with molecular biology. The use of IT helps in faster analysis of data. Especially in genetics this is important as amount of data can be very huge.

196. Explain (in one or two lines) the function of following

(i) Promoter

(ii) tRNA

(iii) Exons

Ans : **FOREIGN 2020**

(i) **Promoter :** It acts as an inition signal which function as recognition centre for RNA-polymerase provided the operator gene is switched on.

(ii) **tRNA :** It acts as an adapter molecule which transfers amino acids to ribosomes for synthesis of polypeptides.

(iii) **Exons :** These are coding sequences or expressed sequences in an eukaryotic gene. The exon sequences appear in mature or processed RNA.

197. How is a polypeptide chain synthesis terminated during protein synthesis?

Ans : **COMP 2019**

Synthesis of polypeptide chain terminates when a nonsense codon of mRNA reaches the A-site. There are three nonesense codon UAA, UAG and UGA, which are not recognised by any of the tRNAs. Therefore no more amino-acyl tRNA reaches the A site. The P site t-RNA is hydroplysed and the completed polypeptide is released in the presence of GTP dependent release factor.

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198. What is a promoter in a transcription unit? Where is it located in DNA with reference to the structural gene?

Ans : **FOREIGN 2006**

Promoter is a DNA sequence that provides binding site for RNA polymerase and it is the presence of a promoter in a transcription unit that defines the template and coding strand.

It is located in the upstream of structural gene, and by convention it is called 5′ end.

199. What is a terminator? What is its significance in transcription?

Ans : **OD 2012**

The terminator is a component of transcription unit, which defines the end of the process of transcription. It is a code on the mRNA for which the tRNA has no anticodon and so the polypeptide chain breaks.

200. Mention any four applications of DNA fingerprinting?

Ans : **COMP 2015**

DNA fingerprinting is used in :

(i) DNA forensics, for identification of criminals

(ii) DNA fingerprinting, for solving paternity disputes

(iii) determining population and genetic diversities

(iv) studying the breeding patterns of animals facing the danger of extinction

201. What do you understand by operon. Name the first operon to be discovered?

Ans : **OD 2011**

An operon is a part of genetic material (or DNA), which acts as a single regulated unit having one or more structural genes, an operator gene, a promoter gene, a regulator gene, a repressor and inducer or co-repressor.

The first person to be discovered was lac-operon

from transcription bubble. Now, newly synthesised RNA strands goes for further processing.

(iii) **Translation :** Translation is the process in which formation of protein takes place from RNA stand. Here genetic specific amino acid to form a polypeptide chain. The basic outline of translation process is as follows.

(a) Binding of mRNA to the two subunits of a ribosome.

(b) Initiator codon on mRNA (AUG) binds to first anti codon of tRNA (UAG). This tRNA carries the amino acid methionine.

(c) The next codon on the mRNA determines the next tRNA anti codon. Which binds with it and so, the next amino acid in the polypeptide.

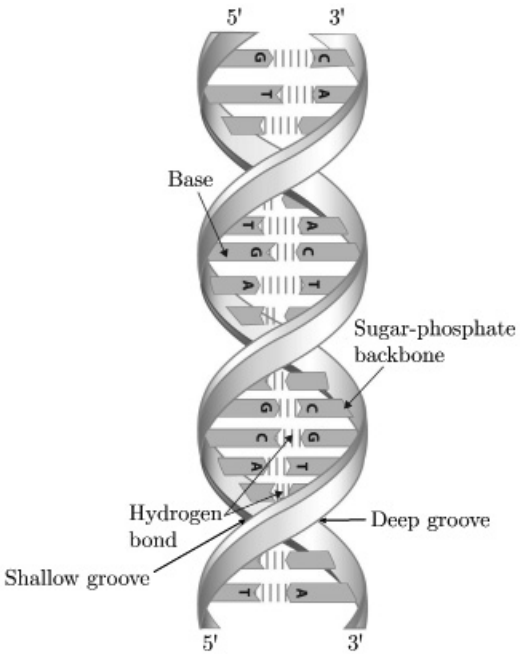
(d) A peptide bond forms between the amino acids. The tRNA detaches from the ribosome and returns to the cytoplasm to pick up another amino acid.

(e) The process continues, with codons matched by appropriate tRNA anti codons and peptide bonds forming between the amino acids.

(f)Eventually a stop codon is reached on the mRNA. The ribosome releases the mRNA and the newly formed polypeptide (further processing of the polypeptide may occur to make it functional).

230. Draw the double helical structure of DNA as proposed by Watson and Crick.

Ans : **OD 2012**



231. Prove with two evidences that DNA is a genetic material.

Ans : **OD 2010**

The chemical substance which transmits characters from one generation to another generation is known as genetic material.

For several years RNA was considered to be genetic material of living organisms but the work carried out by Griffith (1928), O.T. A very, C.M. Macleod and M.McCarty (1944) and Hershey and Chase (1952) produced evidence that DNA, rather than RNA is the carrier of hereditary information.

The two evidences in support of DNA as genetic material are as follows.

(i) Experiment of a very, Macleod and Mc Carty(1944) : These scientists provided the first conclusive evidence that DNA indeed was the transforming principle and consequently also the genetic material involved in hereditary mechanism in bacteria.

They isolated and identified the chemical nature of Griffith's transforming principle. They had shown that highly purified DNA from heat killed S type cells could transform R type cells into S type in the in vitro system. They had also demonstrated that enzymes that degrade DNA (the deoxyribonucleases) could destroy the transforming factor. Again that had demonstrated that RNA and protein isolated from heat killed S type cells fail to transform R type cells into S type. The DNA induced transformation was a permanent and heritable characteristic.

(ii) Experiment of Hershey and chase (1952) : Afred Hershey and Martha chase provided an unequivocal proof that DNA is the genetic material came from their experiments. They worked with viruses that infect bacteria called bacteriophages.

They made two different preparations of the phage. In one, the DNA was made radioactive with ^{32}P and in the other, the protein coat was made radioactive with ^{35}S. The phage containing radioactive DNA was radioactive that found in the bacterial cells indicting that tha DNA is the genetic material.

232. Explain the chromosome theory of heredity.

Ans : **OD 2009**

The chromosomal theory of inheritance was proposed by walter Sulton and Theodore Boveri. This theory was experimentally proved by

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(ix) Thus, he concluded that some transforming material transferred from the heat killed S-type cells had enabled the R-type cells to synthesis mucus coat and become virulent and this must be due to the transfer of genetic material (transforming principle).

(x) Oswald Avery, Colin Mac Leod and Maclyn Mc Carty (1933-44) later discovered that DNA form the heat killed S-cells had transformed the R-strain of Bacteria.

(xi) They conducted biochemical characterisation of transforming principle by using proteases, RNAses and DNAses.

(xii) They observed that proteases and RNAses did not affect transformation, but DNAse inhibited the transformation. They concluded that DNA is the genetic material.

237. Describe the Hershey and Chase experiment. Write the conclusion drawn by the scientists after their experiment.

Ans : **COMP 2010**

Hershey and Chase conducted their experiments on the T_2 phage, a virus. The phage consists only of a protein shell containing its genetic material.

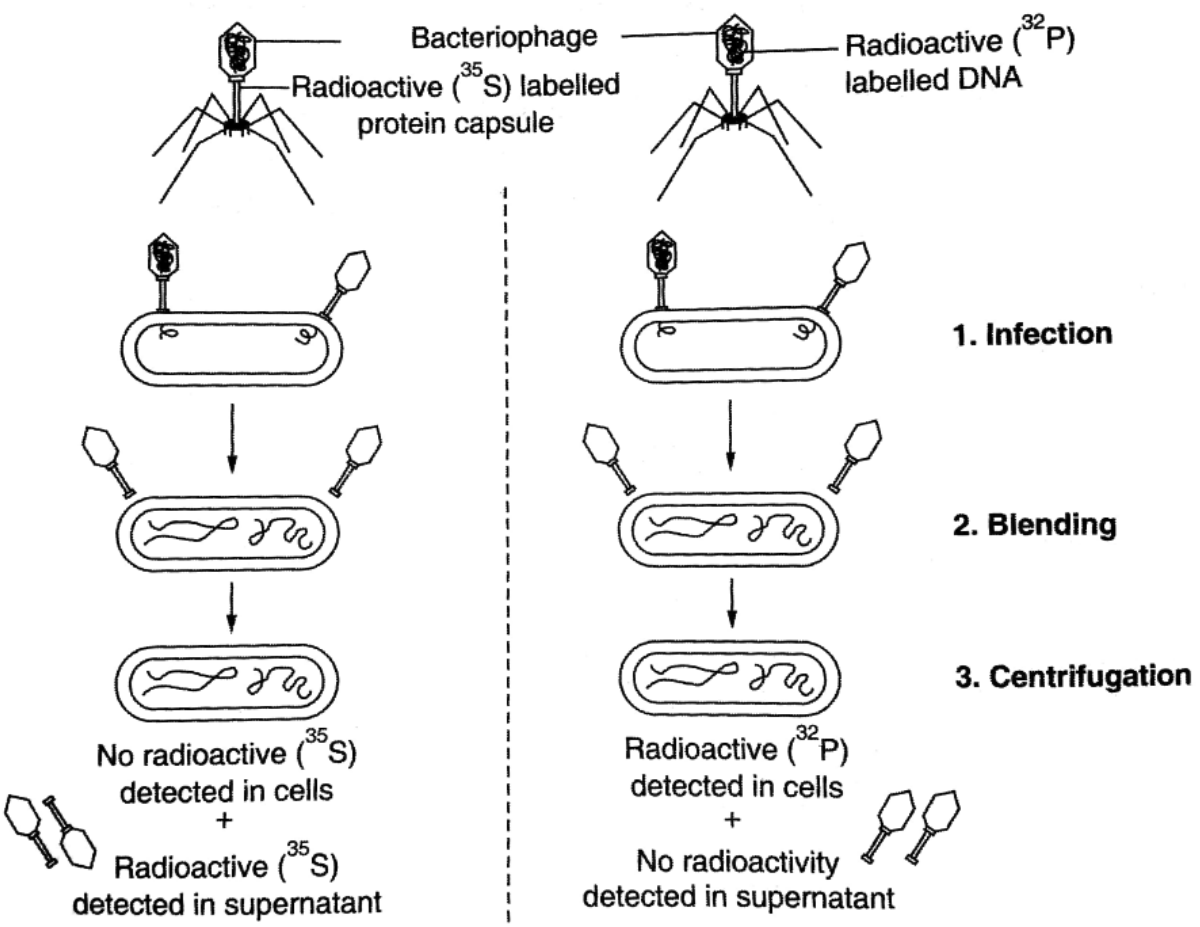
(i) In the first experiment, they labelled the DNA of phages with radioactive Phosphorus-32 (the element phosphorus is present in DNA but not present in any of the 20 amino acids from which proteins are made).

(ii) They allowed the phages to infect *E*.coli, then removed the protein shells from the infected cells with a blender and separated the cells and viral coats by using a centrifuge.

(iii) They found that the radioactive tracer was visible only in the pellet of bacterial cells and not in the supernatant containing the protein shells.

(iv) In the second experiment, they labelled the phages with radioactive sulphur-35 (Sulphur is present in the amino acids cysteine and methoionine, but not in DNA).

(v) After separation, the radioactive tracer then was found in the protein shells but not in the infected bacteria, supporting the hypothesis that the genetic material which infects the bacteria is DNA.



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235. (i) Name the molecule 'X' synthesised by 'i' gene how does this molecule get inactivated?

(ii) Which one of the structural genes codes for β -galactosidase?

(iii) When will the transcription of this gene stop?

Ans : **DELHI 2018**

(i) X is repressor molecule. It gets inactivated by the interaction with the inducer-lactose.

(ii) Gene G codes for β-galactosidase ($\beta - gal$).

(iii) The transcription of this gene would stop when repressor protein binds to operator region (o); thus preventing RNA polymerase from transcribing operon in basence of an inducer.

236. Describe Frederick Griffith's experiment on streptococcus pneumoniae. Discuss the conclusion he arrived at.

Ans : **FOREIGN 2005**

Bacterial Transformation (Griffith's experiment)

(i) It was performed by Frederick Griffith (1928) on the bacteria Streptococcus pneumoniae (bacteria responsible for causing pneumonia).

(ii) This bacteria has two strains-

(iii) S-Type (smooth, virulent and with mucus coat)-can cause pneumonia.

(iv) R-Type (rough, avirulent, without mucus coat) cannot cause pneumonia.

(v) Mice infected with S-type of cells die from pneumonia.

(vi) Mice infected with R-type of cells do not develop pneumonia.

(vii) Griffith observed that heat killed S-cells didn't kill the mice.

(viii) When a mixture of heat killed S-cells and live R-cells was injected then mice died. Moreover, he recovered living S bacteria from the dead mice.

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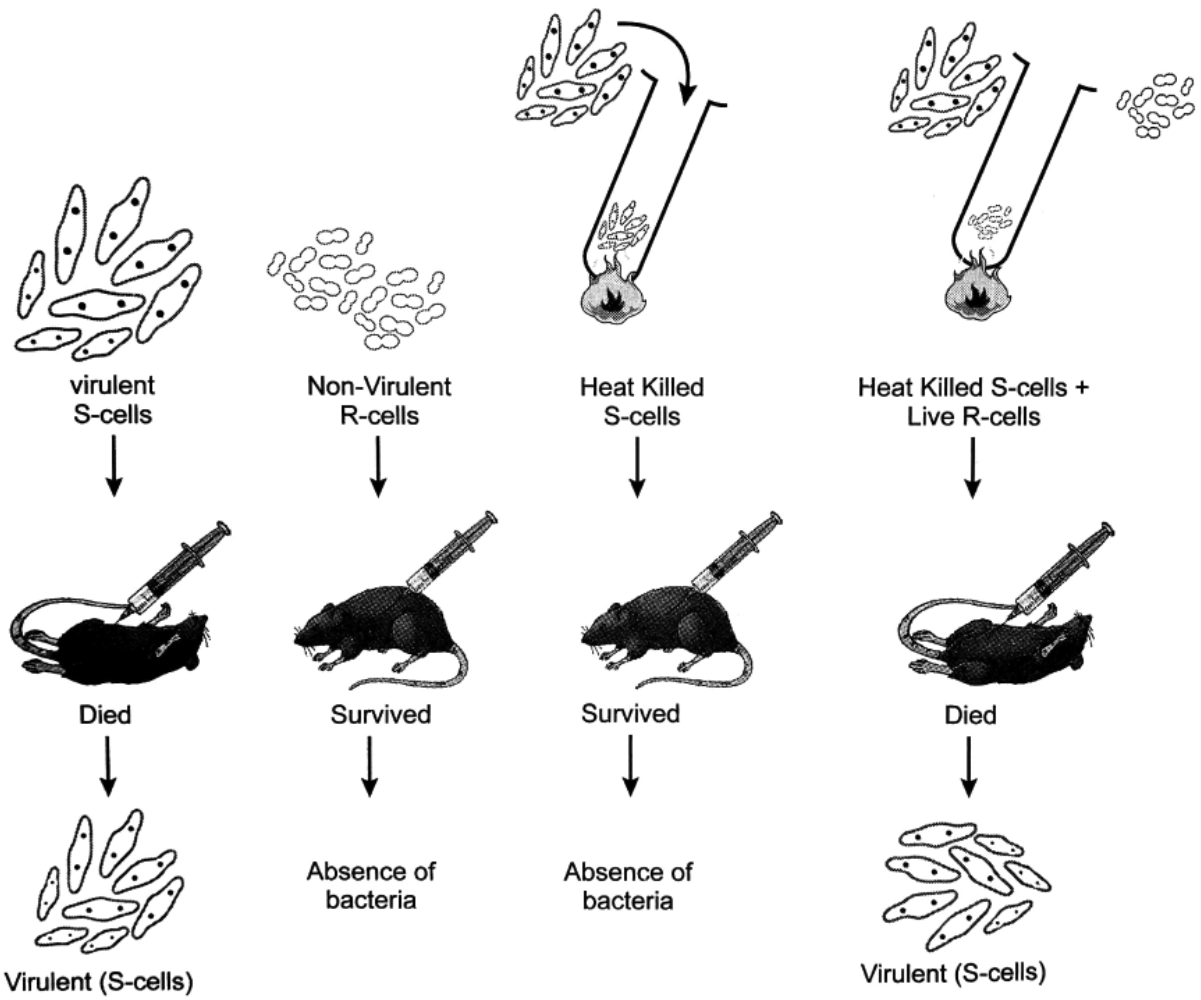


individual. The variable number of tendem of repeats (VNTR's) are essential elements in DNA fingerprinting. The "probe" is "a satellite DNA that shows very high degree of polymorphism." VNTR is a class of satellite DNA called mini satellite.

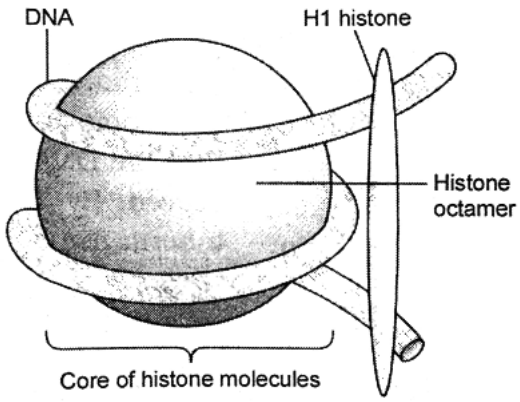
242. Mention what enables histone to acquire a positive charge.

Ans : SQP 2012

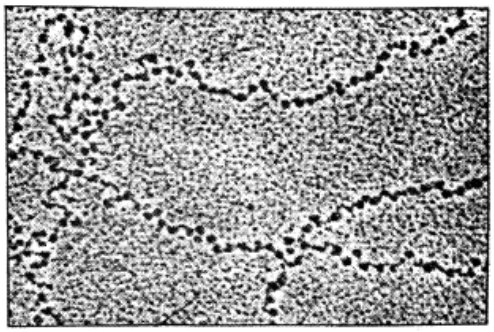
Organisation of DNA : Packaging of DNA helix is not required. In prokaryotes DNa is organised in large loops that are held by proteins. DNA lies in nucleoid (ac there is no nucleus). DNA organisation in eukartyotes is complex. DNA is linked to histones (basic proteins).

Nucleosome Concept : The chromatin fibre has beads on a string appearance. Each bead is known as nucleosome. It is made of DNA and histones. The histone is organised to form a unit of eight histone molecules. It is called 'histone octamer'. The Negatively charge DNA is wrapped aorund positively charged 'histone-octamer' to make the structure named the nucleosome.

A typica nucleosome consists of 200 bp (base pairs) of DNA helix. The neucleosomes make repeating unit of a structure in nucleous termed as the 'chromatin'. They are thread like stained (coloured) bodies seen in nucleus. Nucleosomes in chromatiin are observed as 'beads-on-string' structure when studied under electron microscope. This is packaged to make nucleoprotein fibre or chromatin fibers. On coiling and condesnation at metaphase stage these form "the chromosome". Therefore packaging of chromating at higher level needs additional set of proteins which are called 'Non-Histone Chromosomal or NHC proteins'. Histones are basic proteins. H_2A, H_2B, H_3 and H_4 form octamer. H_1 is tissue specific and occurs once in 200 bp.



(a) Nucleosome



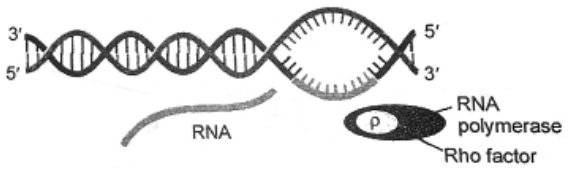
(b) EM photo-beads on the string

243. What is a gene? Explain Transcription Unit.

Ans : COMP 2015

Gene and Transcription Unit : The gene is referred as "functional unit of inheritance or heredity." They lie on DNA. DNA sequence coding for t-RNA defines a gene. A cistron is a segment of DNA coding for a polypeptide. The structrual gene in a transcription unit would be then **mono-cistronic**.

It occurs mostly in eukaryotes. It may be 'polycistronic in bacteria or prokaryotes mostly. But in eukartyotes, mono-cistronic structural genes posses interrupted coding sequences. So the genes in eukaryotes are split. The coding sequences are called exons. In bacteria m-RNA does not need processing to become active. The transcription as well as the translation occur in same compartment. Because there is no separation of cytosol and nucleus in bacteria; the translation may start much before m-RNA is completely transcribed. As a result, the transcription and translation are coupled in bacteria (prikaryotes).



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238. Give an account of post transcriptional modifications of a eukaryotic mRNA.

Or

Mention how is the process different in eukaryotes.

Ans : OD 2015

Split Genes : In the eukaryotes, gene is are interrupted by non-coding sequences which are called introns. The introns are removed and the exons are to produce functional RNA by splicing process.

There are two additional complexities in eukaryotes:

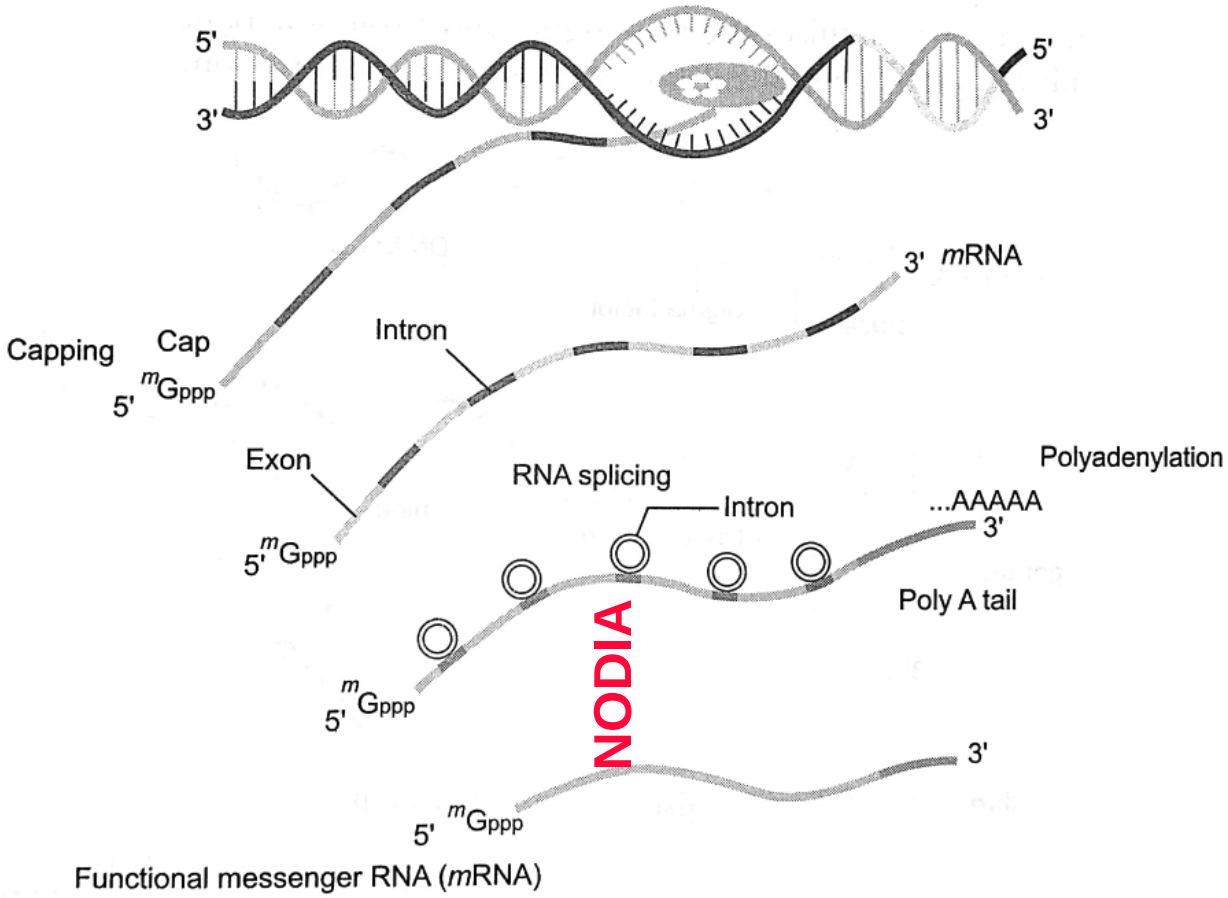
(i) There are 3 RNA-polymerases in nucleus of the cell. It seems that there is a division of labour. RNA-Polymerase I transcribes r-RNAs i.e., 28s, 18s and 5.8s, RNA polymerase-III is responsible for transcription of t-RNA, 5srRNA, and snRNAs or small nuclear RNAs. RNA polymerase II transcribes precursor of m-RNA. It is called heterogneous nuclear RNA or hnRNA.

(ii) The primary transcript consists of both exons as well as introns. This is non-functional. This primary script is subjected to 'splicing'. In this process, introns are removed but the exons are joined in a defined way.

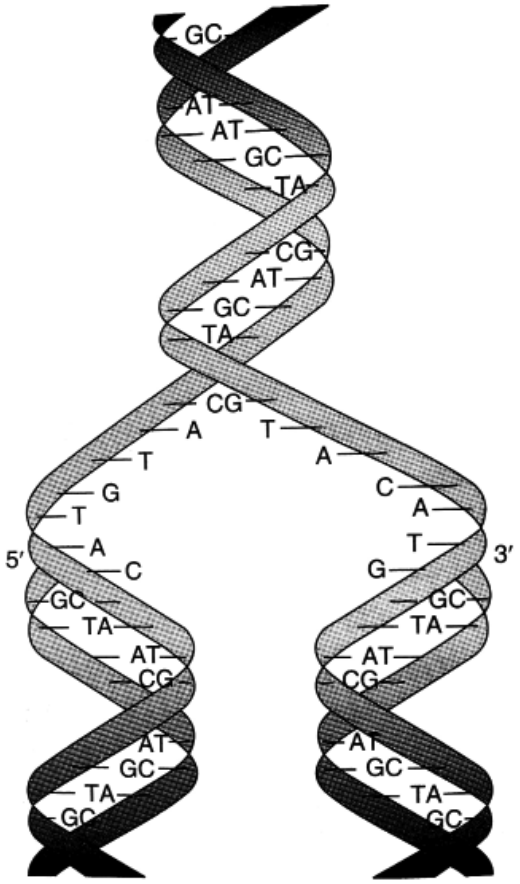
The heterogenes nulcear RNA (hnRNA) undergoes 2 additional processing which are (a) capping and (b) tailing.

(a) In **'capping'** an unusual nucleotide methyl guanosine triphosphate is added to the 5' end of heterogenes nuclear RNA.

(b) In **'tailing'**, adenylate residues app. 200-300 are inserted at 3'-end in a **template independent way**. Fully processed heterogenous nuclear RNA is then known as the **m-RNA**. This is transported out of nucleus for translation process.



held in place on the parent the template chain the free nucleotides were sewn together by formation of phosphodiester bonds by ligase enzyme.



247.(i) What is promoter unit in relation to gene expression? Why in eukaryotes there are more promoter units as compared to prokaryotes?

(ii) Where do transcription and translation take place in a eukartyotic cells?

(iii) What is splicing?

Ans : **OD 2018**

(i) **Pormotor Unit in Gene Expression :** The activity of RNA polymerase at a given promotor is regulated by interaction with accessory proteins that influences its capability to recognize start sites in prokaryotes.

Accessibility of promotor region of the prokayyotic DNA is regulated by interaction of proteins with sequences termed the operators. Origin is adjacent to the promotor (p) elements in most sperm and sequences of operator is found in lac operon.

(ii) **Transcription :** It involves "the formation of a mRNA strand on the DNA template". It occurs in nucleus of the cell. This process also involves the unwinding of DNa and transcription starts at a specific point. An enzyme, RNA polymerase recognises the point at which transcription should start and the point at which it should stop. These points are identified by special sequence of bases. However, only one of the two strands of DNa gives rise to meaningul RNA. This process requires the building blocks. A,U, G and C as their corresponding nucleotide forms. The base sequence in DNA decides the base sequence in RNA as A pairing with U and G pairing with C. The information DNA, coded in the sequence of bases of cistron, is transcribed to RNA ans is catalysed by the RNA-polymerase. Many mRNA may be synthesised in rapid succession along a cistron. The completed mRNA moves away and binds to a group of ribosomes in the cytoplasm.

Translation process in protein synthesis : It occurs in ribosomes.

(a) It is the assembly of polypeptide chain. For initiation, a ribosome binds to mRNA at start codon (AUG) which is recognized only by initiator tRNA. Ribosome proceeds to elongation phase of the protein synthesis then.

(b) Afterwards the complexes, made of an amino acid linked to tRNA, sequentially bind to suitable codon in mRNA by forming complementary base pairs (bp) with tRNA anticodon.

(iii) **Splicing :** When m-RNA is formed from split genes, the unwanted RNA regions are removed while regions coding for amino acids are joined together. This process is called splicing.

248. Describe how the lac operon operates, both in the presence and absence of an inducer in E.coli

i	p	o	z	y	a

Or

Given above is the schematic representation of lac operon of E.coli. Explain the functioning of this operon when lactose is provided in the growth medium of the bacteria.

Or

How are the structural genes activated in the lac operon in E. coli?

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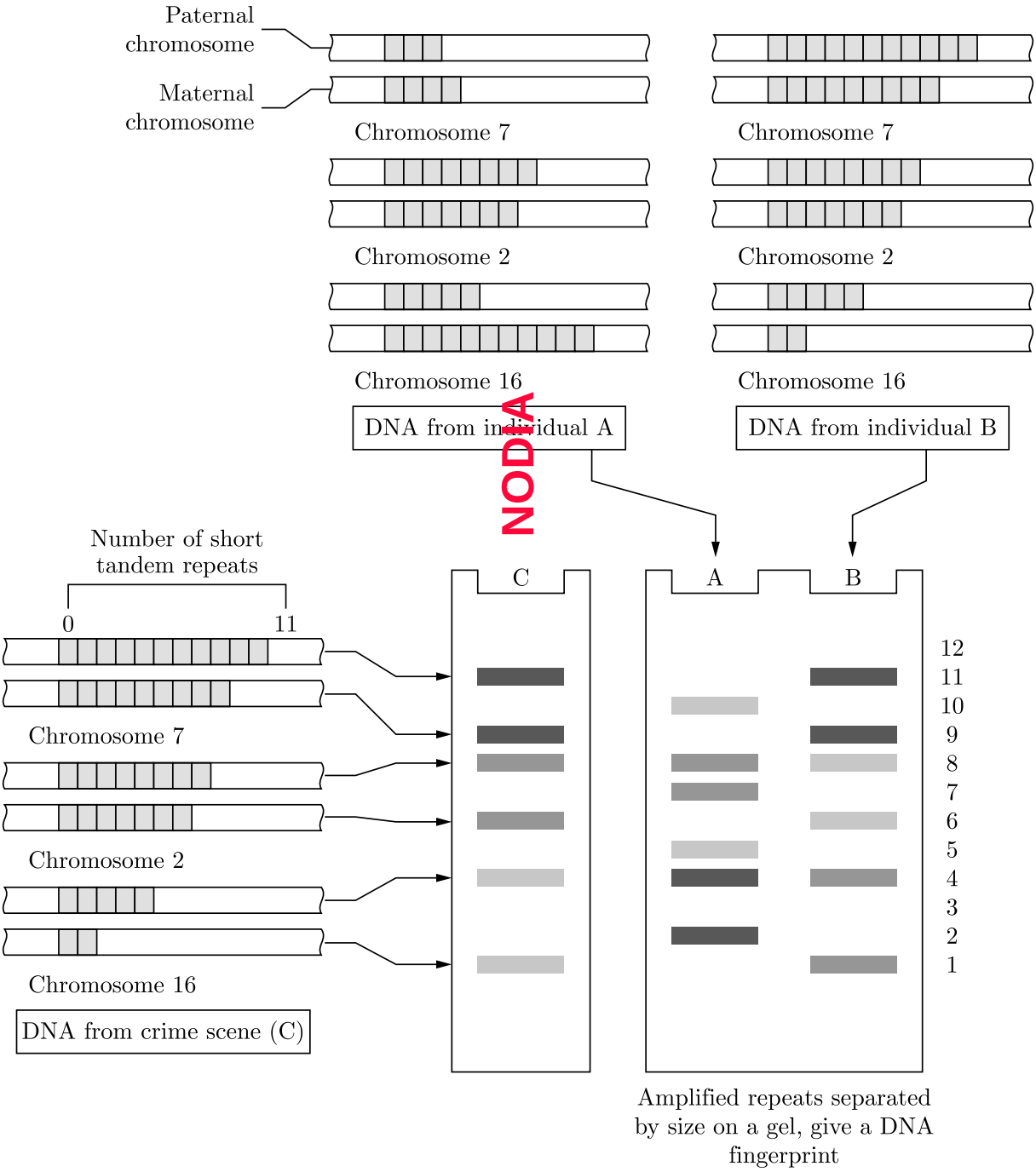

241.(i) Explain DNA polymorphism as the basis of genetic mapping of human genome.

(ii) State the role of VNTR in DNA fingerprinting.

Ans : FOREIGN 2016

(i) **DNA Polymorphism is the basis of DNA fingerprinting :** The DNA polmorphism means "variations at the genetic level" that arise due to sudden changes (mutations). The non-coding sequences of DNA do not have any impact on individual's reproductive capacity but accumulate in the generation. VNTR's are useful in DNA fingerprinting. Two applications of DNA fingerprinting other than in forensic science are : (a) DNA fingerprinting plays role in determining population. (b) To determine genetic diversities.

(ii) **VNTR's :** These are hypervariable regions or segments of short nucleotide sequences. These regions are specific in each person or

Thomas Hunt Morgan and his colleagues by his experiments on Drosophila. The main postulates of this theory are as follows:

(i) The genes are carried on the chromosomes.

(ii) Chromosomes are also found in pairs like the Mendelian alleles.

(iii) The two alleles of a gene pair are located on homologous sites on the holmologous chromosomes.

(iv) Homologous chromosomes synapse during meiosis and get separated to pass into different cells. This is the basis for segregation and independent assortment.

(v) All hereditary character must be with sperms and egg cells as they provide bridge from one generation to the other.

(vi) The sperm and egg have haploid sets of chromosomes, which fuse to re-establish the diploid state.

233. (i) Give reason for

(a) Both strands of DNA are not copied during transcription.

(b) Transcription and translation in bacteria can be coupled.

(ii) Differentiate between the process of transcription in prokaryotes and eukaryotes.

Ans : **FOREIGN 2005**

(i) (a) If both strands of DNA function as template, then these can code for the RNA having various sequences. If coded for polypeptides; they must have different amino acid sequences which will make the protein synthesis complex. When two RNA molecules are produced they will be complementary to one another; consequently dsRNA would result and to prevent RNA from being translated into protein.

(b) In prokaryotes, the mRNA synthesis does not required any processing to become active and since both transcription and translation occur in the same cytosol; translation can start much before the mRNA is fully transcribed. Consequently, transcription and translation can be coupled.

(ii) The difference between the process of transcription in prokaryotes and eukaryotes are as follows :

	Transcription in Prokaryotes	**Transcription in Eukaryotes**
(i)	Products of transcription become effective in situ.	Products of transcription come out of the nucleus for functioning in cytoplasm.
(ii)	There is only one RNA-polymerase	Three RNA polymerases take part in it.
(iii)	mRNA is polycistronic.	mRNA is monocistronic
(iv)	Splicing is not required.	Splicing is required for removing introns.

234. One chromosome contains one molecule of DNA. In eukartyotes the length of the DNA molecule is enromously large. Explain how such a long molecule fits into the tiny chromosomes seen at Metaphase.

Ans : **SQP 2023**

Eukaryotic Chromosome : This chromosome is complex in organisation due to greater amount of DNA per chromosome. The totallength of DNA double helix in a eukartyotic/mammalian cell may be 2.2 m and the dimession of eukaryotic nucleus may be 10^{-6} m only. This is packed in chromosome in the nucleus. In human 46 chromosomes if taken together will measure about in 2 metres. This chromatin material is present inside the molecules. DNA is associated with positively charged histones but less positively charged histone but less positively charged non-histone proteins. DNA and histones form spherical structures called the Nucleosomes.

Each nucleosome consists of an octamer of histones. A length of DNA is wrapped around the histones to make the nucleosome. A nuclosome possesses 200 base pair (bp) of DNA helix. H_1 histone is located outside the nucleosomal DNA in the linker region. The nucleosome makes the chromatin that are thread like structures seen at Metaphase by microscope.

The packaging of chromatin into coiled chromatin fibres needs the NHC (non-histone chromosomal) proteins. In nucleus, some regions of chromatin are loosely packed (It takes light stain) are called euchromatin but more densely dark stained regions are known as heterochromatin.

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244. How is the functioning of lac operon different from that of tryptophan operon?

Ans : **OD 2020**

Differences between Lac operon and Tryptophan operon are as follows :

	Lac Operon	**Tryptophan Operon**
(i)	In lac opm eron, Jacod and Monod found the *E*. coli was grown on a medium containing lactose. It showed the synthesis of three new enzymes i.e., β-galactosidase, permease and transactetylase under three genes.	Tryptophan operon conssits of five structural genes that code for five different enzymes catalysing the synthesis of an amino acid trypto-phan in *E*.coli cells.
(ii)	The genes have the information to code for amino acid sequence and so the synthesis of enzymes.	It is repressible system where the tryptophan acts as a co-repressor.

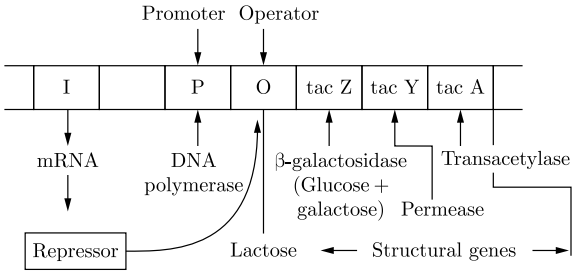


Fig Lactose operon consisting of various genes for lactose digestion

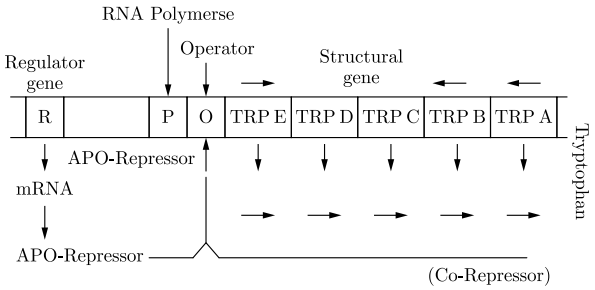
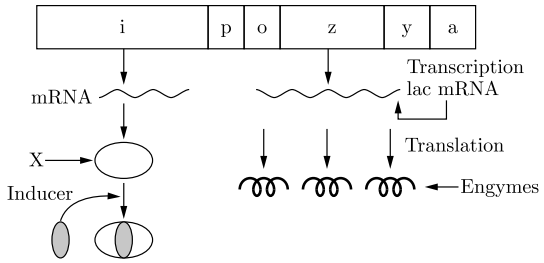


Fig Tryptophan operon

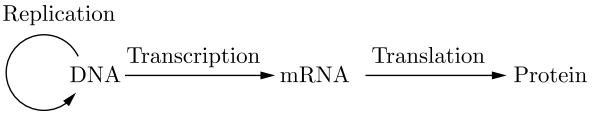


245. (i) State the Central Dogma in Molecular biology. Who proposed it? Is it universally applicable? Explain.

(ii) List any four properties of a molecule to be able to act as a genetic material.

Ans : **COMP 2016**

(i) **Francis Crick** Proposed central dogma in molecular biology. It states that "genetic information flows DNA → RNA → Protein."



In some viruses, flow of information is in reverse direction, i.e., from RNA to DNA.

(ii) A molecule that can be able to act as a genetic material must fulfill the following four criteria:

(a) It must be able to generate its replica that is replication.

(b) It must chemically and structurally be stable.

(c) It must provide scope for slow change or mutation which are needed for evolution.

(d) It must be able to express itself in form of Mendelian characters.

246. Describe the various step of DNA replication.

Ans : **FOREIGN 2008**

Watson and Crick suggested the double twisted helix structure of DNA molecule. These two workers suggested that the two strands of a DNA molecule manufacture the replica of their own and in the process of replication each DNA might serve as a template (base) for the synthesis of its complementary strand.

Then follows the formation of new complementary polynucleotide chains along the sides of the original lone pair. The enzyme that helps in replication is DNA polymerase now also called DNA polymerase I. During formation each and pyrimidine base of each nucleotide strand is thought to attract a complementary free nucleotide available for polymerization in cell and hold in place by means of specific hydrogen bonds. Once

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239. Define an operon giving an example, explain an Inducible operon.

Ans : FOREIGN 2005

Lac operon : It includes one regulatory gene and three structural genes-Z, Y and A which codes for three enzymes. Z gene codes for b-galactosidase enzyme; Y gene codes for permease enzyme; A gene codes for transacetylase enzyme.

In lac oepron polycistronic structural gene is regualtd by a promoter and regulatory genes. According to F. Jacod and J. Monod (1961), in *E*.coli, the metabolic pathways are reuglated as a unit. When the sugar lactose is added to the culture of *E*.coli, b-galactosidase, permease and transacetylase are produced which are needed for metabolism of lactose. Lactose acts as inducer. The expression of genes depends on the switch on and switch off. When "switches on" the three genes are transcribed by RNA polymerase into a single stretch of mRNA covering all the three genes : mRNA traslates into proteins.

When lactose is added, a few molecules of it get into the cell by the action of the enzyme permease. These few molecules are then converted into an active form of lactose, which binds to the repressor protein. Thus the repressor cannot bind to the operator switch and when lactose i snot added, the repressor protein bind to the operator and the genetic system remains in "switch off" position and there is no transcription and so no translation at all, no m-RNA synthesis and thereby no protein synthesis.

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240. 'There is a paternity dispute for a child'. Which technique can solve the problem? Discuss the principle involved.

Or

Forensic department was given three blood samples. Write the steps of the procedure carried to get the DNA fingerprinting done for the above samples.

Ans : DELHI 2008

Isolation of desired DNA :

(i) **DNA Polymorphism : Basis of DNA finger printing :** DNA polymorphism means "variation at the genetic leve" that arise due to sudden changes (mutations). The non-coding sequences of DNA do not have any impact on individual's reproductive capacity but accumulate in the generation. VNTRs are useful in DNA finger printing.

(ii) **Two applications of DNA finger printing other than in forensic science :**
- (a) DNA finger printing plays role in determining population.
- (b) To determine genetic diversities.

(iii) **The steps followed in DNA finger printing are :**
- (a) The isolation of the desired DNA from small amounts of blood, semen or other cells of body.
- (b) The digestion of DNA by restriction endonuclease enzyme.
- (c) The blotting of separated DNA fragments to synthetic membrane e.g., nylon or nitrocellulose membranes.
- (d) The hybridization by use of labelled VNTR probe (mini satellite).
- (e) By autoradiography, the detection of hybridised DNA fragments is done.

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Ans : **DELHI 2013**

Lac operon in *E* coli : According to F. Jacob and J. Monod, in *E*. coli the metabolic pathways are regulated as a unit : When the sugar lactose is added to the culture of *E*. coli these three enzymes- β galactosidase, permease and transacetylase are produced. The genes for these three enzymes are linked and are known as structural genes. These structural genes have the information to code for the amino acid sequence and thus directly decide the structure and function of the individual protein of the pathway.

These three genes, coding for three enzymes are regulated as unit by a single switch known as operator. This entire unit is known as operon. The operator gene is controlled by a regulator gene through regulator protein.

The expression of genes depends upon the on or off of the switch. When switch is one the three genes are transcribed by RNA polymerase into a single stretch of mRNA covering all the three genes : mRNA translates into proteins.

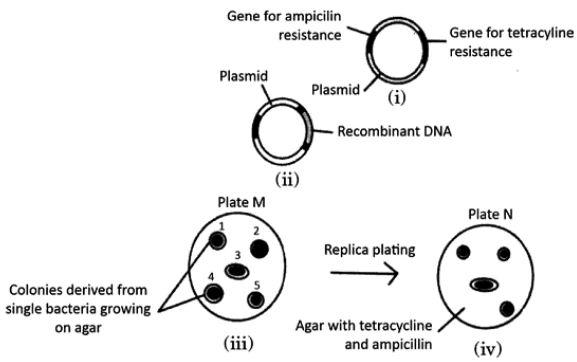
DNA → mRNA → Proteins

When lactose is added a few molecules of it get into the cell by the action of the enzyme permease. These few molecules are then converted into an active form of lactose, which binds to the repressor protein. Thus the repressor can not bind to the operator switch.

But when lactose is not added, the repressor protein bind with the operator and the genetic system remain in switch off position. Thus there will be no transcriptions and hence no translation; thereby no mRNA synthesis and no protein formation occurs.

CASE BASED QUESTIONS

249. Study the diagram given below that shows the steps involved in the procedure of selecting transformed bacteria and answer the questions that follow :



(i) Identify the colony that has got transformed. Justify your answer.

(ii) What are the sites in a plasmid called where ampicillin and tetracycline resistance genes are inserted ? State their role in genetic engineering.

(iii) Name two enzymes playing an important role in genetic engineering.

(iv) State the role of $\beta-$ galactosidase in insertional inactivation.

Ans :

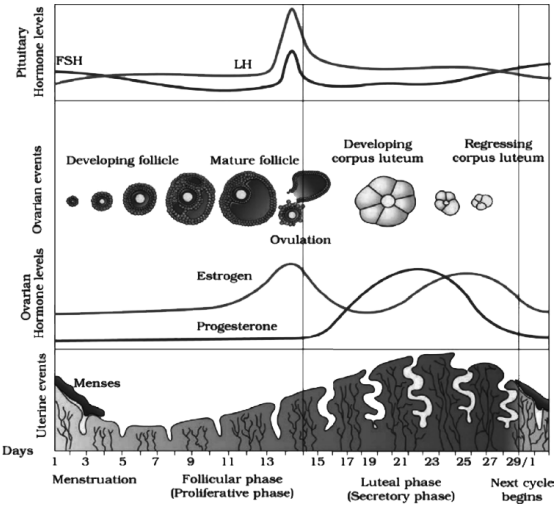
(i) Colony 4 is transformed with plasmid containing recombinant DNA, as they will not show resistance towards tetracycline.

(ii) Award 2 marks to each student.

(iii) Restriction endonuclease / ligase / *Taq* DNA Polymerase

(iv) Insertional inactivation of gene encoding for $\beta-$ galactosidase will lead to colorless bacterial colonies (recombinant)

250. In a human female, the reproductive phase starts on the onset of puberty and ceases around middle age of the female. Study the graph given below regarding menstrual cycle and answer the questions that follow :



(i) Name the hormones and their source organ, which are responsible for menstrual cycle at puberty.

(ii) For successful pregnancy, at what phase of the menstrual cycle an early embryo (upto 3 blastomeres) should be Implanted in the Uterus (IUT) of a human female who has opted for Assisted Reproductive Technology (ART) ? Support your answer with a reason.

(iii) Name the hormone and its source organ responsible for the events occurring during

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6.5 Biochemical Evidence

The similarities in protein and genes performing a common given function among diverse organisms give clues to common ancestry .the metabolic processes in organism are also similar with same new material and end products.

6.6 Biological Evidence

Species restricted to a region develop unique features species presents in widely separated regions show similarity of ancestry.

6.7 Embryological Evidence

According to Ernst Haeckel early embryological development stages of vertebrates show certain features that are common to all vertebrates and absent in adult, support concept of organic evolution.

7. RECAPITULATION THEORY

Recapitulation theory (iogenetic law) states that an animal during its development (ontogeny) repeats certain ancestral stages of its evolution (phylogeny). For example, the embryos of all vertebrates including human develop a row of vestigial gill slits just behind the head but it is a functional organ only in fish and not found in any other adult vertebrates. However, Karl Ernst von Baer noted that embryos never pass through the adult stages of other animals.

8. LAMARCK THEORY

Lamarck in his theory of inheritance of acquired characters proposed that evolution of life forms occurred but driven by use and disuse of organs. Elongated necks in Giraffes is a acquired character, slowly, over the years.

9. DARWIN'S THEORY OF NATURAL SELECTION

Branching descent and natural selection are the two key concepts of Darwinian theory of evolution.

It is based on certain facts such as rapid multiplication of organisms, limited natural resources (food and space), competition for resources, some survive and grow at the cost of others. Members of a population show variations.

Variations which make resource utilisation better for few (adapted to habitat better) and enable these to reproduce and leave more progeny (Reproductive fitness), over a period of time, of many generations. There would be a change in population characteristic and new forms /species appear to arise.

10. MUTATION THEORY OF EVOLUTION

Hugo de Vries proposed that mutations-large differences arising suddenly in a population cause evolution and not by minor heritable continuous variations, Evolution for Darwin was gradual while de Vries believed evolution to be jerky where large mutations caused speciation and hence called saltation (single step large mutation).

11. MODERN SYNTHETIC THEORY OF EVOLUTION

The modern synthetic theory of evolution is the result of the work of a number of scientists namely T. Dobazhansky, R. A. Fisher, J. B. S. Haldane, Swell Wright, Ernst Mayr and G. L. Stebbins. Stebbins in his book, Process of Organic Evolution discussed the synthetic theory as Mechanism of evolution. It includes the genetic variation in population, natural selection and reproductive islation.

12. HARDY-WEINBERG

Hardy-Weinberg principle states that in a given population, the frequency of occurrence of alleles of a gene is supposed to remain fixed and even remains same through generations. This is also called genetic equilibrium. Sum total of all the alleles is I. Hence, $p^2 + 2pq + q^2 = I$ (P Q represent the frequency of gene A and allele a).

13. FIVE FACTORS AFFECTING HARDY-WEINBERG EQUILIBRIUM

Five factors affecting Hardy-Weinberg equilibrium are gene migratin of gene flow, genetic drift, mutation, genetic recombination and natural selections.

14. TYPES OF NATURAL SELECTION

Operation of natural selection on different traits is of three types Stabilising, directional and disruptive.

15. COELACANTH

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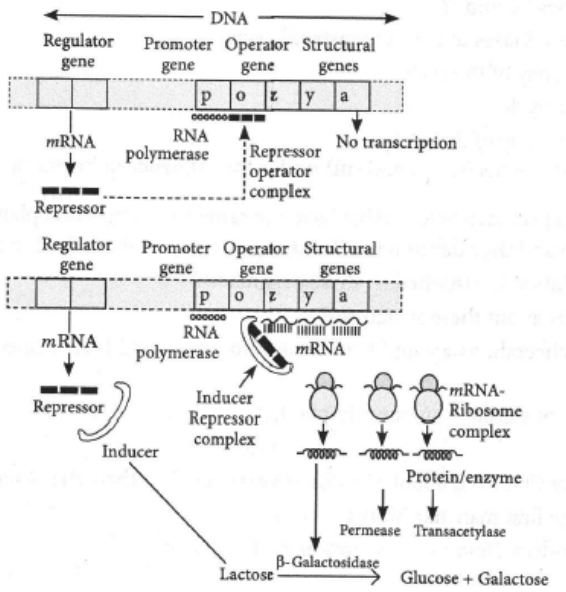
Coelacanth a living fossil, a fish called lobefin, caught in S. Africa in 1938 evolved into first amphibian that lived in both land and water and were ancestors of modern day frog and salamander. The amphibians evolved into reptiles. They lay thick-shelled eggs and have turtles, tortoises and crocodiles as modern descendants. The land reptiles were dinosaurs and the biggest of them i. e. Tyrannosaurus rex about 20 ft. in height, having huge dagger-like teeth. About 65 mya dinosaurs suddenly disappeared due to climatic changes. Small sized reptiles of that era still exist today e.g. Lizard. Some reptiles evolved into birds and some into mammals.

cannot move over it to reach the structural genes. Thus, structural genes are inactivated and transcription cannot take place.

(iii) As regulatory gene exerts a negative control over the working of structural genes, therefore regulation of lac operon is called negative regulation.

(iv) Lactose is an inducer molecule. The products of the genes '*z*' and '*y*' of the lac operon are 13-galactosidase and permease respectively. β-galactosidase brings about hydrolysis of lactose to form glucose and galactose. Galactoside permease is required for entry of lactose into the bacterium.

253. Lac operon is a unit of co-ordinated control of protein synthesis which consists of an operator gene which controls the activity of a number of structural genes which take part in the synthesis of proteins. The operator gene, in return is under the control of a repressor molecule synthesised by a regulator gene, which is not a part of the operon.



(i) When will be the lac operon switched on in E.coli?

(ii) E.coli cells with mutated z gene cannot grow in medium containing only lactose. Justify

(iii) What will happen if the operator gene (o gene) of lac operon is mutated?

(iv) How are the structural genes inactivated in lac operon in E.coli ? Explain.

Ans :

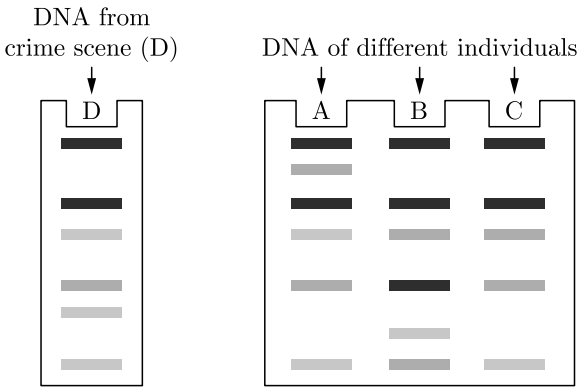
(i) In the presence of an inducer, such as lactose or allolactose in E. coli , the repressor is inactivated by interaction with the inducer. This allows RNA polymerase access to the promoter and transcription proceeds.

(ii) z gene codes for the enzyme P-galactosidase which is responsible for the hydrolysis of lactose into its monomeric units, galactose and glucose. So, E. coli cells with a mutated gene and having only lactose as a source of energy could not grow.

(iii) If there is a mutation in the operator gene, the repressor cannot bind to it. Thus, the operon will express continuously.

(iv) Lac operon in E.coli consists of structural genes, an operator gene, a promoter gene, a regulator gene, a repressor and an inducer. The structural genes are inactivated in the absence of an inducer (i.e., lactose). It is because in the absence of an inducer, the repressor binds to the operator gene making it non-functional. RNA polymerase enzyme cannot move over it to reach the structural genes. Thus, structural genes are inactivated and transcription cannot take place.

254. Study the given below picture of the gel electrophoresis showing the banding pattern of DNA from crime scene.



Amplified repeats in different individuals

(i) On the basis of the above given picture of gel electrophoresis, among A, B and C who will be the criminal? Give reason.

(ii) Which technique is used in the given question for the identification of the criminals?

(iii) On what basis, the DNA fragments of individual A, B and C are separated in the gel electrophoresis?

(iv) What is the basis of technique which is used in the criminal investigation and forensic science?

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20. In the animals, the same structures developed along the different directions due to the adaptations to different needs. This is called
(a) convergent evolution
(b) divergent evolution
(c) disruptive evolution
(d) directional evolution

Ans : OD 2005

Divergent evolution is the accumulation of differences between groups which can lead to the formation of new species. Usually, it is a result of diffusion of the same species to different and isolated environments.
Thus (b) is correct option.

21. Divergent evolution gives rise to
(a) homologous organs
(b) analogous organs
(c) Both (a) and (b)
(d) None of these

Ans : DELHI 2013

Homologous Organs the organs which have the same fundamental structure but are different in functions are called homologous organs. Homologous organs are the resultant of divergent evolution.
Thus (a) is correct option.

22. Fossils are the remains of
(a) hard part of life forms found in rocks
(b) light part of life forms found in rocks
(c) protein and bones of life forms found in rocks
(d) fat and protein of life forms found in rocks

Ans : OD 2019

Fossils are the remains of hard parts of life-forms found in rocks. Rocks forms sediments and a cross-section of earth's crust indicates the arrangement of sediments one over the other during the long history of earth.
Thus (a) is correct option.

23. The eyes of Octopus and eyes of cat show different patterns of structure, yet they perform similar function. This is an example of
(a) homologous organs that have evolved due to convergent evolution
(b) homologous organs that have evolved due to divergent evolution
(c) analogous organs that have evolved due to convergent evolution
(d) analogous organs that have evolved due to divergent evolution

Ans : OD 2010

The analogous organs are not anatomically similar structures though they perform similar functions. Hence, analogous structures are a result of convergent evolution. i.e. different structures evolving for the same function and hence, having similarity.
Therefore, the eyes of Octopus and eyes of cat are examples of analogous organs.
Thus (c) is correct option.

24. The process by which organisms with different evolutionary history evolve similar phenotypic adaptations in response to a common environmental challenge, is called
(a) natural selection
(b) convergent evolution
(c) non-random evolution
(d) adaptive radiation

Ans : SQP 2007

Convergent evolution occurs in unrelated group of organisms. It is the development of similar functional structures but in unrelated groups.
Thus (b) is correct option.

25. Biochemical similarities are based on study of
(a) similarities in carbohydrates of organisms
(b) similarities in fat (fatty acid) of organisms
(c) similarities in protein and genes of organisms
(d) All of the above

Ans : DELHI 2005

The different types of biochemical reactions occur in every living organism. These reactions are same in all the living organisms.
Thus (c) is correct option.

26. Change of lighter coloured variety of peppered moths (Biston betularia) to darker variety in the industrial era occurred due to
(a) selection of darker variety for survival
(b) deletion of gene
(c) industrial carbon deposited on the wings
(d) translocation of gene

Ans : FOREIGN 2008

Change of light coloured variety of the peppered moths to the darker variety is an excellent example with supports the theory of natural selection by Charles Darwin.
Thus (a) is correct option.

27. Natural indicator of industrial pollution is
(a) algae (b) fungi
(c) lichen (d) bacteria

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CHAPTER 6

EVOLUTION

SUMMARY

1. EVOLUTIONARY BIOLOGY

Evolutionary biology is the study of history of life forms on earth. The origin of life is considered a unique event in the history of universe.

2. BIG BANG

Big bang theory attempts to explain the origin of universe, a tremendous explosion due to large-scale collision between particles and antiparticles gave rise to hydrogen and helium.

The gases condensed under gravitation and formed galaxies. In the solar system of the milky way galaxy, earth was supposed to have been formed 4.5 billion years back.

3. ORIGIN OF LIFE

Life appeared almost about 4 billion years back us. Some important theories about the origin of life are :

1. **Theory of Special Creation :** All living organisms were created as such.
2. **Theory of spontaneous generation** (abiogenesis or autogenesis) from decaying and rotten matter like straw, mud, etc.
3. **Theory of Panspermia :** units of life called spores or cosmozoa reached earth from some other heavenly body.
4. **Theory of chemical evolution and biological evolution** proposed by Oparin and Haldane.

4. THIS THEORY OF BIOGENESIS

This theory of biogenesis i.e., chemical evolution preceded biological evolution is accepted by majority. First cellular form of life originated about 2000 million years ago. They were single-celled heterotrophs.

5. BIOLOGICAL EVOLUTION

First simple cellular forms evolved into present day complex diversity by a process called evolution. This is also called biological or organic evolution.

6. EVIDENCES FOR BIOLOGICAL EVOLUTION

Organic evolution is a process of cumulative changes of living population and in the descendant Populations of organisms. It is **descent with modification.**

6.1 Palaeontological Evidence

Palaeontological evidence (fossil evidence)- Fossils are remnants of hard parts of life or their impressions found in rocks. Different aged rock sediments contain fossil of different types. `Early rocks contain fossils of simple organisms while recent rocks contain fossils of complex organisms, e.g., dinosaur.

6.2 Anatomical and Morphological Evidence

Organisms which show similarities in characteristics are placed in one group. Comparative anatomical study of various parts of body provides evidence for evolution.

6.3 Homologous Organs

The same structure developed along different directions due to adaptations to different needs. This is divergent evolution and these structures are called homologous, e.g., vertebrate hearts or brains. In plants, thorn of Bougainvillea and tendrils of Cucurbita represent homology as both are modified stems. Homology indicated common ancestory.

6.4 Analogous Organs

Some organisms have organs which have similar function but they are different in anatomical structural details and origin. These structures are called analogous structures. They are a result of convergent evolution.

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5. Which of the following factors is important in the formation of new species?
(a) Competition
(b) Mutation
(c) Isolation
(d) Continuous Variation

Ans : OD 2012
The process of formation of new species from the populations of existing species is called as speciation. The factors responsible for speciation are geographic isolation, variation natural selection, genetic drift etc.
Thus (c) is correct option.

6. Evolutionary biology is
(a) the study of history of life forms on earth
(b) study of pedigrees of life forms on earth
(c) equivalent to demography
(d) equivalent to anthropology

Ans : DELHI 2005
Evolutionary biology is the study of history of life forms on earth.
Evolution simply means an orderly change from one condition to another. Evolution is a continuous process in which decent with modification are produced.
Thus (a) is correct option.

7. For a long time it was believed that life came out of decaying and rotting matter like straw mud, etc. This was the theory of
(a) catastrophism
(b) spontaneous generation
(c) panspermia
(d) chemogeny

Ans : DELHI 2012
Theory of spontaneous generation (Abiogenesis or Autogenesis).
This theory states that, life originated from non-living things in a spontaneous manner. This concept was held by early Greek philosophers like Thales, Anaximander, Xanophanes, Empedocles, Plato, Aristotle, etc.
Thus (b) is correct option.

8. Who discarded the theory of spontaneous generation forever?
(a) Louis Pasteur (b) Francisco Redi
(c) Spallanzani (d) Aristotle

Ans : FOREIGN 2016
Theory of spontaneous generatin was disapproved by many scientist. Noted scientist were
1. Francisco Redi (1626-1697)
2. Lazzaro Spallanzani (1729-1799)
3. Louis Pasteur (1822-1895)

Louis Pasteur's swan neck experimentfinally disapproved abiogenesis and powered biogenesis (life originated from pre existing one).
Thus (a) is correct option.

9. Who proposed that the first form of life could have come from pre-existing non-living organic molecules?
(a) SL Miller
(b) Oparin and Haldane
(c) Charles Darwin
(d) Alfred Wallace

Ans : COMP 2006
Thus (b) is correct option.

10. Experimental evidence of chemical evolution was given by
(a) Miller (b) Haldane
(c) Oparin (d) All of these

Ans : OD 2011
Stanley Miller in 1953, who was than a graduate student of Harold Urey (1893-1981) at the university of Chicago, demonstrated it clearly that ultra-violet radiation or electric discharges can produce complex organic compounds from mixture of CH_4, NH_3, H_2O and H_2. The ratio of methane, ammonia and hydrogen in Miller's experiment was 2 : 1 : 2.
Thus (a) is correct option.

11. Miller synthesised simple amino acids from one of the following mixtures in his experiment.
(a) CH_4, NH_3, H_2 and water vapours
(b) H_2, O_2, N_2 and water vapours
(c) H_2, O_2, C_2 and water vapours
(d) CH_4, NH_3, O_2 and water vapours

Ans : SQP 2007
Experimentally chemical theory of evolution performed by SL Miller and HC Uray in 1953.
He created electric discharge in a closed flask containing CH_4, H_2, NH_3 and water vapours at 800 C. He observed formation of amino acids. In similar experiments other the observed, formation of sugar, nitrogen bases, pigments and fats.
Thus (a) is correct option.

12. What did miller obtained from his experiment?
(a) Amino acid
(b) Organic compounds
(c) Peptide
(d) All of the above

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16. HUMAN EVOLUTION

1. About 15 mya primates called Dryopithecus and Ramapithecus, were hairy and walked like gorilla, were existing. Dryopithecus appeared 25 mya, first-ape, common ancestor of man and great apes, arms and legs of equal length.
2. Ramapithecus is the forerunner of hominid evolution. Ramapithecus appeared 15 mys, ape like primates, lived on tree tops, travelled and ate on ground, could walk erect on feet, became extinct about 7 mya.

   About 3-4 mya man-like primates walked in East Africa.
3. Australopithcus appeared 4-5 mya, african ape-man probably lived in East African grassland, not taller than 4-ft but walked upright, hunted with stone weapons and ate fruits.
4. Homo-habilis appeared 2 mya, the tool maker community life in caves, because of large brain regarded as human form Homo (man) habilis (skilful), carnivorous, hunted large animals.
5. Fossils discovered in java revealed the next stage i.e. Homo erectus about 1.5 mya had a brain capacity around 900 cc. He probably ate meat, knew use of the more elaborate tools protruding jaws, projecting brow ridges, small canines, large molars.
6. Between 100000-40000 years lived Neanderthal man near east and central Asia, brain 1300-1600 cc used hides to protect the body and buried their dead knew use of fire (modern man) Omnivore, lived in caves.
7. Homo sapiens arose in Africa between 34000-10000 years ago, moved across continents and developed into distinct races.
8. Homo sapiens fossils also called cro-magnon man-the fossil of modern man, evolved in Africa and migrated, to other regions, intermixing helped in merging of Neanderthalensis with cro-magon man, leading to Homo sapiens sapien. Thus, he was the direct ancestor of living modern man (Homo sapiens sapiens).

OBJECTIVE QUESTIONS

1. Adaptive radiation in Australian maruspials are example of:
(a) Divergent evolution
(b) Convergent evolution
(c) Saltation
(d) None of these

Ans : **OD 2024**
Adaptive radiation in Australian marsupials are example of divergent evolution. All the marsupials in present day Australia would have evolved from one common ancestor. Over time and via natural selection many marsupial species have occupied their own ecological niche and adapted accordingly.
Thus (a) is correct option.

2. Appearance of antibiotic resistance bacteria is an example of:
(a) Adaptive radiation
(b) Transduction
(c) Pre existing variation
(d) Divergent evolution

Ans : **OD 2018**
Appearance of antibiotic resistance in bacteria is an example of pre-existing variation in the population. When a bacterial population encounters a particular antibiotic, those sensitive to it die. But some bacteria having mutations become resistant to antibiotic. Soon, the resistance providing genes become wide spread and the entire population become resistant.
Thus (c) is correct option.

3. Inheritance of acquired characters was given by:
(a) Darwin (b) Lamarck
(c) de Vires (d) Haeckel

Ans : **OD 2017**
The law of inheritance of acquired characters was given by Lamarck. It is also called as theory of use and disuse of organs.
Thus (b) is correct option.

4. Echidna is
(a) connecting link (b) vestigial organ
(c) extinct link (d) none of these

Ans : **OD 2015**
Echidna or spiny ant eater is a egg laying mammal of order monotremata. It is a connecting link between reptiles and mammals.
Thus (a) is correct option.

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Ans :

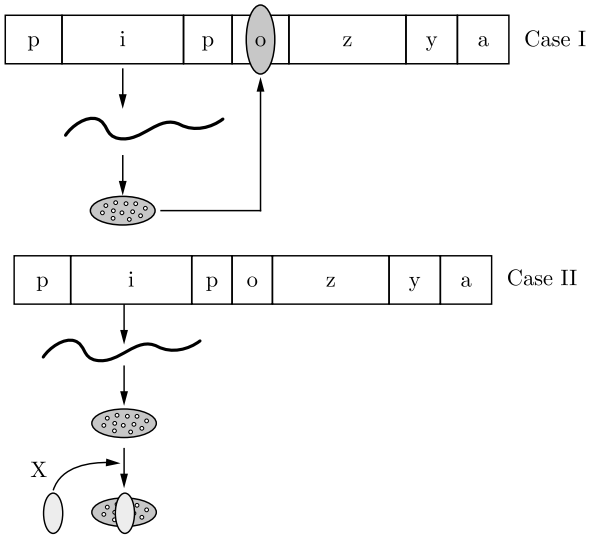
(i) Individual C is identified as a criminal because the banding pattern of the different chromosome is exactly identical to the sample D obtained from the crime scene.

(ii) DNA fingerprinting technique is used for the identification of the criminals.

(iii) The DNA fragments of individuals A, B and C are separated on the basis of their size in the gel. The smaller the fragment size the farther it moves in the gel.

(iv) The DNA fingerprinting technique is used in the field of forensic science and for criminal investigation. It is based on the specific regions in DNA sequence called as repetitive DNA that shows the high degree of polymorphism.

255. From a number of studies on the metabolism of bacterium *Escherichia coli*, two French scientists Jacob and Monod in 1961 found that the genetic material possesses regulated gene units called operons. Study the given below operon system operating in *E.coli* and answer the questions that follow:



(i) On the basis of the given operon system, what conclusion can you draw about case I and case II?

(ii) What would happen in the presence of X in case II?

(iii) What type of regulation can be seen in the given operon system by the repressor?

(iv) Which structural gene codes for permease in both the cases and what is its function?

Ans :

(i) In case I, transcription of structural genes does not takes place while in case II, transcription will turn on.

(ii) In case II, in the presence of X (inducer) it will binds to the repressor and make it inactive. Thus, turn on the transcription.

(iii) Regulation of *lac* operon by repressor is referred to as negative regulation.

(iv) In *lac* operon, the permease is encoded by structural gene y, which increases permeability of the cell to 13-galactosidase.

256. Translation requires a machinery which contains of ribosome, mRNA, tRNA aminoacyl tRNA synthetase and amino acids.
The initiator tRNA is specific for the process of initiation and there are no RNA forestop condon.

(i) How many sub units of ribosome are there ?

(ii) What are untranslated regions (UTR) ?

(iii) List the different arnis of tRNA.

Ans :

(i) Ribosome has 2 subunits i.e., smaller and larger subunit.

(ii) The UTR is the untranslated region found on mRNA that are not translated.

(iii) The tRNA has five arms i.e., anticodon loop, amino acid acceptor arm, T-loop, $p-$ loop and variable loop.

257. Franois Jacob and Jaeque Monad in the year 1961 were the first to propose the concept of a transcriptionally regulated system, where a polycistronic structural gene is regulated by a common promoter and regulatory gene.

(i) How many structural gene are there in a lae-operon. What does they code for.

(ii) What does i gene synthesise ?

(iii) What does the regulation of lac operon by repressor is called

Ans :

(i) Three structural genes are :
(a) Z gene : β galactosidase
(b) Y gene : permease
(c) a gene : transacetylase

(ii) Repressor of the operon.

(iii) Negative regulation

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Ans : **COMP 2009**

Miller circulated four gases methane, ammonia, hydrogen and water vapours in an air tight apparatus and passed electrical discharges from electrode at 800° C. After week, he found a large number of simple organic compounds including amino acid such as alanine glycine, aspartic acid. Other substances such as urea, hydrogen cyanide, lactic acid and acetic acid were also present.
Thus (d) is correct option.

13. Information molecule the most likely evolved first on the primitive earth was
(a) protein (b) DNA
(c) RNA (d) All of these

Ans : **DELHI 2005**

In the first living body basic organic molecule formed was RNA that served as the genetic material.
Thus (c) is correct option.

14. What was the name of the sail ship used by Charles Darwin during his sea Voyage?
(a) HMS Beagle (b) HSM Beagle
(c) HMS Eagle (d) HSM Eagle

Ans : **OD 2015**

Based on observation made during a sea voyage in a sail ship called HMS Beagle round the world, Charles Darwin conclude that the existing living forms share similarities to varying degrees not only among themselves but also with the life forms that existed millions of years ago.
Thus (a) is correct option.

15. Evolution is
(a) discontinuous process
(b) stochastic process
(c) Both (a) and (b)
(d) non-essential process

Ans : **SQP 2013**

Evolution is a process of unfolding. Evolution is not a directed process and is based on chance events and chance mutations in organisms.
Thus (c) is correct option.

16. Fitness according to Darwin refers to
(a) reproductive fitness
(b) physiological fitness
(c) spiritual fitness
(d) None of these

Ans : **FOREIGN 2008**

The fitness, according to Darwin, refers ultimately and only to reproductive fitness. Hence, those who are better fit in an environment, leave more progeny than other. These, therefore will survive more and, hence are selected by nature. He called it natural selectional and implied it as a mechanism of evolutions.
Thus (a) is correct option.

17. Scientist who also came to the similar conclusions around the same time of Charles Darwin was
(a) Alfred Wallace
(b) Hugo de Vries
(c) TH Morgan
(d) Oparin and Haldane

Ans : **2012**

Alfred Wallace (1823-1913) was a naturalist from Britain. He wrote an essay tittle **On the Tendencies of varieties to Depart Indefinitely from the original type**.
Thinking of both Darwin and Wallace in respect of organic evolution was similar.
Thus (a) is correct option.

18. Malay Archipelago stands for
(a) a group of islands visited by Wallace
(b) research paper on evolution written by Wallace
(c) research paper on ecology written by Wallace
(d) a group of organism studied by Wallace

Ans : **DELHI 2014**

Malay Archipalago is an island group in Southeast Asia between Australia and the Asian mainland and it separates the Indian and Pacific oceans. It includes Indonesia, the Philippines, and the Malaysia.
Thus (a) is correct option.

NODIA

19. Evidence that evolution of life forms has indeed taken place on earth has come from
(a) fossil studies (palaeontological evidences)
(b) morphological and comparative anatomical study
(c) biochemical study
(d) All of the above

Ans : **COMP 2017**

There are many evidences of evolution these evidences of evolution mainly came from
1. Evidences from the fossil (Palaeontological studies)
2. Morphological study
3. Anatomical study
4. Biochemical study
5. Phylogenetic tree

Thus (d) is correct option.

proliferative phase of menstrual cycle. Explain the event.

(iv) In a normal human female, why does menstruation only occurs if the released ovum is not fertilised ? Explain.

Ans : **OD 2024**

(i)

Hormone	Source Organ
FSH	Pituitary gland
LH	Pituitary gland
Estrogen	ovary / graafian follicle
Progesterone	ovary / corpus luteum

(any two hormones with their relevant source organ)

(ii) Luteal phase or Secretory phase of the menstrual cycle, as endometrium grown and suitable for implantation of an early embryo or blastocyst.

(iii) Estrogen, ovary / graafian (mature) follicles Endometrium of uterus regenerates through proliferation.

(iv) If ovum is not fertilized corpus luteum degenerates, progesterone level falls, disintegration of endometrium (and its blood vessels), leading to menstrual flow.

251. Gene expresses itself in a cell system as a protein/enzyme. How does an expression of gene occur in a cell system and when does it need to occur, and how the gene expression is regulated in a prokaryote cell system was studied by the combined efforts of Jacque Monod, the biochemist and Francois Jacob, the geneticist. For their work on lactose metabolism in *E. coli* and introducing the concept of "lac operon" they were awarded the Nobel Prize in 1965.

(i) Why is lac operon said to be a transcriptionally regulated system ?

(ii) It is said that the lac operon has to be operational at a very low level in the bacterial cell all the time. Justify.

(iii) Why is the regulator gene in lac operon marked as 'I' gene ?

(iv) Draw a schematic diagram of lac operon in absence of inducer in the culture medium of the bacteria.

(v) Draw a schematic diagram of lac operon in the presence of inducer in the culture medium of the bacteria.

Ans : **COMP 2023**

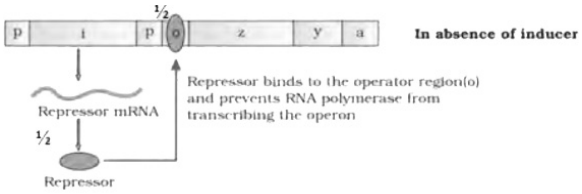
(i) In presence of lactose repressor protein dose not bind to the operator region (O) and allow RNA polymerase to transcribe the operon.

In absence of lactose repressor protein bind to the operator region (O) and prevent RNA polymerase from transcribing the operon.

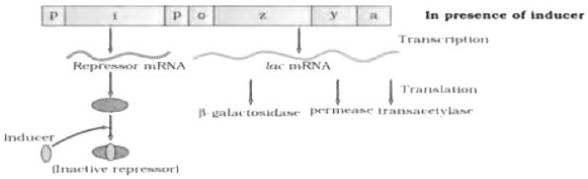
(ii) Presence of Permease enzyme coded by gene 'y' is required that allows lactose to enter the cell for switching on the operon / so that lactose enter inside the cell.

(iii) 'i' stands for 'inhibitor/ this gene transcribes repressor protein which binds to the 'operator' site and switch off the operon.

(iv)



(v)



252. Study the schematic representation of the genes involved in the lac operon given below and answer the questions that follow:

p	*i*	*p*	*o*	*z*	*y*	*a*

(i) Identify and name the regulatory gene in this operon.

(ii) What is the role of inducer in the given figure?

(iii) Why is the lac operon's regulation referred to as negative regulation?

(iv) Name the inducer molecule and the products of the genes '*z*' and '*y*' of the operon. Write the functions of these gene products.

Ans :

(i) The given schematic representation is of lac operon. In lac operon, the regulatory gene is called i-gene because it produces an inhibitor or repressor. The repressor binds to operator gene and stops the operator from working.

(ii) In the absence of an inducer (i.e., lactose), the repressor binds to the operator gene making it non-functional. RNA polymerase enzyme

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Ans : **COMP 2012**

Lichens are very sensitive to the air pollution specially to the sulfur dioxide. Lichens are the symbiotic association of algae and fungi. Generally, lichens are not found in the industrial areas.
Thus (c) is correct option.

28. Example justifying that anthropogenic actions lead to evolution is the use of which of the following on large scale?
(a) Herbicides (b) Pesticides
(c) Antibiotics (d) All of these

Ans : **DELHI 2019**

Excess use of herbicides, pesticides, etc., has only resulted in the selection of resistant varieties in a much lesser time scale. This is also true for microbes against, which we employ antibiotics or drugs. Hence, resistant organisms/cells are appearing in a time scale of months or years and not centuries. These are the examples of evolution by anthropogenic action.
Thus (d) is correct option.

29. Industrial melanism is an example of
(a) neo Darwinism (b) natural selection
(c) mutation (d) neo Lamarckism

Ans : **FOREIGN 2023**

Industrial melanism is a term used to describe the evolutionary process in which darker individuals come to predominate over lighter individuals since the industrial revolution as a result of natural selection.
Thus (b) is correct option.

30. Development of different functional structures from a common ancestral form is called
(a) differential evolution
(b) adaptive radiation
(c) non-adaptive radiation
(d) regressive evolution

Ans : **COMP 2021**

The evolutionary process, which produces new species, diverged from a single ancestral form adapted to new invaded habitats and to modes of life necessary there, is known as adaptive radiation.
Thus (b) is correct option.

31. The diversity in the type of finches and adaptation to different feeding habits on the Galapagos islands, as observed by Darwin, provides an evidence of
(a) origin of species by natural selection
(b) intra-specific variation
(c) intra-specific competition
(d) inter-specific competition

Ans : **DELHI 2009**

The organisms which are provided with favourable variations would survive because they are fittest for their surroundings while, the unfit organisms are destroyed.
Thus (a) is correct option.

32. Development of similar adaptive functional structural features in an unrelated group of organism is called
(a) adaptive radiation
(b) adaptive convergence
(c) Both (a) and (b)
(d) evolution

Ans : **SQP 2011**

Adaptive radiation is a result of divergent evolution.
Adaptive radiation are observed after a major extinction event.
Thus (b) is correct option.

33. Australian marsupials are the example of
(a) homologous radiation
(b) analogous radiation
(c) adaptive radiation
(d) convergent radiation

Ans : **DELHI 2005**

Australian Marsupials Darwin explained that adaptive radiation gave rise to the varieties of marsupials (pouched mammals) in Australia by the same process of adaptive radiation as found in the finches of Galapagos Islands.
Thus (c) is correct option.

34. Which of the following is not an examples of adaptive radiation?
(a) Wombat, numbat, flying phalanger
(b) Darwin's finches
(c) Different mammals in other parts of world
(d) Lemur and spotted cuscus

Ans : **OD 2011**

In evolutionary biology, adaptive radiation is a process in which the organisms diversify rapidly into a multitude of new forms, particularly when a change in the environment makes the new resources available and opens the environmental niches. Lemur and spotted cuscus are a case of convergent evolution.
Thus (d) is correct option.

NODIA

74. Assertion : The primitive atmosphere was reducing one i.e., without oxygen.
Reason : In the primitive atmosphere, oxygen was involved in forming ozone.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **SQP 2008**
The lightest atoms of nitrogen, carbon etc. formed the primitive atmosphere. Hydrogen atoms were most numerous and most reactive in primitive atmosphere. Hydrogen atoms combined with all oxygen atoms to form water leaving no free oxygen. Thus primitive atmosphere was reducing (without free oxygen) unlike the present oxidizing atmosphere (with free oxygen).
Formation of ozone layer is the consequence of modern oxidizing atmosphere having plenty of free oxygen. As more oxygen accumulated in the atmosphere (due to photosynthesis) ozone began to appear in the top layers.
Thus (c) is correct option.

75. Assertion : Jave Ape-man, Peking man and Heidelberg man are the fossils of Homo erectus.
Reason : Homo erectus evolved from Homo habilis.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **COMP 2012**
The fossil of Java Ape-man was discovered from pleistocene rocks in central Java. The fossil of Peking man was discovered from the lime stone caves of Choukoution near Peking while that of Heidelberg man was discovered in mid pleistocene. All these three fossils come under the category of Homo erectus. Homo erectus appeared about 1.7 million years ago in the middle pleistocene. H erectus evolved from Homo habilis. He was about 1.5-1.8 metres tall. He had erect posture. His skull was flat than that of the modern man. He had protruding jaws, projecting brow ridges, small canines and large molar teeth. He made more elaborate tools of stones and bones, hunted big animals and perhaps knew the use of fire.
Thus (b) is correct option.

76. Assertion : Natural selection is the outcome of difference is survival and reproduction among individuals that show variation in one or more traits.
Reason : Adaptive forms of a given trait tend to become more common; less adaptive ones become less common or disappear.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **OD 2011**
The Darwin's theory of Natural Selection can be generalised as the change in species by the survival of an organism exhibiting a natural variation that gives it an adaptive advantage in an environment. Thus, leading to a new environmental equilibrium. The idea of the survival of the fittest explains the above evolution by natural selection. According to survival of the fittest, some of the variations exhibited by living things make it easier for them to survive and reproduce. Thus, more adaptive forms increase. Those Which are not fit (or less adaptive) are eliminated.
Thus (a) is correct option.

77. Assertion : Organic compounds first evolved in earth required for origin of life were protein and nucleic acid.
Reason : All life forms were in water environment only.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **DELHI 2015**
Organic compounds that first evolved in earth which required for origin of life were protein and nucleic acid. All life forms were in aquatic environment only.
Thus (b) is correct option.

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(c) Natural selection is the mechanism by which biological evolution takes place
(d) The fossil record supports the view that biological evolution has occurred

Ans : **FOREIGN 2009**

Mutations are random and directionless while Darwinian variations are small and directional. Evolution for Darwin was gradual.
Thus (b) is correct option.

43. Hardy-Weinberg principle is the
(a) stable allele frequency in a population
(b) genetic structure of an evolving population
(c) varying allele frequency in a population
(d) phenotypic structure of a non-evolving population

Ans : **OD 2013**

Hardy-Weinberg principle is the allelic frequency of non-evolving population under stable conditions.
Thus (a) is correct option.

44. Genetic equilibrium refers to phenomenon that
(a) the traits remains constant in a population
(b) the total genes remain constant in a population
(c) the total genes keeps on varying in a population
(d) traits keeps on varying in a population

Ans : **DELHI 2009**

Hardy-Weinberg principle states that, allele frequencies remains constant from generation to generation. This is called as genetic equilibrium.
Thus (b) is correct option.

45. In Hardy-Weinberg law the homozygous dominant alleles (I), homozygous recessive alleles (II) and heterozygous alleles (III), are represented by

(a) I-p^2, II-q^2, III-$3pq$ (b) I-p^2, II-q^2, III-$2pq$
(c) I-a^2, II-p^2, III-$2pq$ (d) I-q^2, II-$2pq$, III-p^2

Ans : **SQP 2014**

In Hardy-Weinberg law
I. Homozygous dominant alleles $= p^2$
II. Homozygous recessive alleles $= q^2$
III. Heterozygous alleles $= 2pq$

$$(p+q)^2 = p^2 + q^2 + 2pq$$

Thus (b) is correct option.

46. The tendency of population to remain in genetic equilibrium may be disturbed by
(a) Random mating
(b) Lack of migration
(c) Lack of mutations
(d) Lack of random mating

Ans : **COMP 2005**

According to Hardy-Weinberg principle, allele frequencies in a population are stable and is constant from generation to generation only if the following conditions are met.
Thus (d) is correct option.

47. Identify the phenomenon in which a new set of population is formed from the set of existing population due to the random excessive change in the allele frequency.
(a) Founder effect (b) Genetic drift
(c) Bottle-neck effect (d) All of above

Ans : **FOREIGN 2016**

Sometime the change in allele frequency is so different in the new sample of population that they become a different species.
The original drifted population becomes founders and the effect is called founder effect.
Thus (a) is correct option.

48. Genetic drift operates in
(a) small isolated population
(b) large isolated population
(c) non-reproductive population
(d) slow reproductive population

Ans : **COMP 2018**

The genetic drift is a drastic change in allele frequency when population size is very small. Its effects are more marked in a small isolated population.
Thus (a) is correct option.

49. In Hardy-Weinberg equation, the frequency of heterozygous individual is represented by
(a) p^2 (b) $2pq$
(c) pq (d) q^2

Ans : **OD 2024, 2020**

Hardy-Weinberg principle states that the allele frequencies in a population are stable and remain constant from generation to generation. This can be expressed by the equation

$$p^2 + 2pq + q^2 = 1$$

or

$$(p+q)^2 = 1$$

where, p^2 represents frequency of homozygous dominant genotype, $2pq$ represents the frequency of heterozygous genotype and q^2 represents the frequency of homozygous recessive genotype.
Thus (b) is correct option.

NODIA

climatic changes and not due to any person/(s).
Thus (c) is correct option.

65. **Assertion :** Coacervates are believed to be the precursors of life.
Reason : Coacervates were self-duplicating aggregates of proteins surrounded by lipid molecules.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **FOREIGN 2023**
Coacervates are large colloidal aggregates formed due to intermolecular attraction from large organic molecules synthesized abiotically on primitive earth. It mainly consists of proteins, polysaccharides and water. They do not fulfil the requirement for probable precursors of life.

A coacervate is a tiny spherical droplet of assorted organic molecules which is held together by hydrophobic forces from a surrounding liquid. Coacervates possess osmotic properties and form spontaneously from certain dilute organic solutions. They were even once suggested to have played a significant role in the evolution of cells and, therefore, of life itself. They are interesting not only in that they provide a locally segregated environment but also in that their boundaries allow the selective absorption of simple organic molecules from the surrounding medium. Coacervates do not have lipid outer membrane, hence they cannot reproduce.
Thus (c) is correct option.

66. **Assertion :** Ginkgo biloba is a living fossil.
Reason : Organism which have persisted and ramin unchanged for the past several million years while their relatives disappeared.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **OD 2014**
Ginkgo biloba, belong to the Ginkgoales evolved during the Jurassic period and is still existing without any morphological or anatomical changes.
Hence, both assertion and reason are correct.
Thus (a) is correct option.

67. **Assertion :** Among the primates, chimpanzee is the closest relative of the present day humans.
Reason : The banding pattern in the autosome numbers 3 and 6 of man and chimpanzee is remarkably similar.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **DELHI 2016**
The banding pattern seen on stained chromosomes from humans and chimpanzee show striking similarities which indicates that they have evolutionary relationships (cytogenetic evidence).
Thus (a) is correct option.

68. **Assertion :** Comparative biochemistry provides a strong evidence in favour of common ancestory of living beings.
Reason : Genetic code is universal.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **COMP 2020**
Comparative biochemistry provides a strong evidence for common ancestors of living beings (e.g. proteins lymph, enzymes, hormones, blood group etc.)
Thus (b) is correct option.

69. **Assertion :** From evolutionary point of view, human gestation period is believed to be shortening.
Reason : One major evolutionary trend in humans has been the larger head undergoing relatively faster growth rate in the foetal stage.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

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modern Homo sapiens arose. Pre-historic cave art developed about 18000 years ago. Agriculture came around 10000 years back and human settlements started.
Thus (d) is correct option.

59. Homo sapiens arose during
(a) ice-age between 75000-10000 years ago
(b) continental drift between 75000-10000 years ago
(c) continental drift between 75000-5000 years ago
(d) ice-age between 50000-10000 years ago

Ans : **OD 2023**

Homo sapiens sapiens (the man of today) appeared about 25000 years ago and started spreading all over the world about 10000 years ago. Morphologically, the transition is marked merely by slight raising of skull cap, thining of skull bones and cranial capacity (1300-1600 CC) and formation of four flexor in vertebral column.
Thus (a) is correct option.

60. What was the most significant trend in the evolution of modern man (Homo sapiens) from his ancestors?
(a) Shortening of jaws
(b) Binocular vision
(c) Increased brain capacity
(d) Upright posture

Ans : **DELHI 2021**

Increased brain capacity was the most significant trend in the evolution of modern man from his ancestors.
Thus (c) is correct option.

61. Homo sapiens neanderthalensis and Cro-magnon man, probably originated from
(a) Homo erectus
(b) Homo habilis
(c) Ramapithecus
(d) Proconsul

Ans : **SQP 2022**

Homo erectus (erect man) appeared about 1.7 million years ago in middle Pleiostocene. Homo erectus was evolved from Homo habilis. He was about 1.5-1.8 metres tall. He was the progenater of two main subspecies Neanderthal and Cro-magnon man.
Thus (a) is correct option.

62. **XX** lived 100000-40000 years ago, in Europe, Asia and Africa. **XX** was short stature, hairy eyebrows, sctreating forehead and large jaws. Identify **XX**
(a) Neanderthal man (b) Homo habilis
(c) Cro-magnon man (d) Dryopithecus

Ans : **FOREIGN 2018**

Neanderthal human were most numerous from about 100000 years ago. They become extinct 10000 years ago. Neanderthals were legendary cave dwellers. They have been protreted as having heavy brows ridges and hamped back. Their fossils were heavy found in Europe and West Asia.
Thus (a) is correct option.

63. The chronological order of human evolution from early to the recent stages is
(a) Ramapithecus → Australopithecus → Homo habilis → Homo erectus
(b) Australopithecus → Ramapithecus → Homo habilis → Homo erectus
(c) Pithecanthropus pekinensis → Homo habilis → Homo erectus
(d) Australopithecus → Ramapithecus → Pithecanthropus pekinensis → Homo erectus

Ans : **COMP 2012**

Chronological order of human evolution
Ramapithecus (first hominid) → Australopithecus (first ape man) → Homo habilis (tool maker handyman) → Homo erectus.
Thus (a) is correct option.

ASSERTION AND REASON

DIRECTION : Each of these questions contains as Assertion following by Reason. Read them carefully and answer the question on the basis of following options. You have to select the one that best describes the two statements.

64. **Assertion :** We have lost all the direct evidence of origin of life.
Reason : The persons responsible for protecting evidences were not skilled.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **COMP 2005**

We have lost all the direct evidences of origin of life only due to destruction of fossils on account of

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35. Example of convergent evolution is
(a) Darwin finches and marsupial mouse
(b) Placental wolf and Tasmanian wolf
(c) Placental wolf and Darwin finches
(d) Tasmanian wolf and marsupial mole

Ans : **FOREIGN 2009**

In convergent evolution two or more different group of organisms develops similar characters due to the same environmental forces. Tasmanian wolf and placental wolf are the examples of convergent evolution.
Thus (b) is correct option.

36. What is meant by the term **Darwin fitness**.
(a) The ability to survive and reproduce
(b) High aggressiveness
(c) Healthy appearance
(d) Physical strength

Ans : **COMP 2016**

Darwin's fitness is related to the organisms ability to survive and reproduce better then the other members of the species.
Thus (a) is correct option.

37. Survival of the fittest is possible due to
(a) over production
(b) favourable variations
(c) environmental change
(d) inheritance of acquired characters

Ans : **COMP 2005**

The organisms, which are provided with the favourable variations would survive because they are fittest to face their surrounding while unfit organism are destroyed.
Thus (b) is correct option.

38. Which of the following situation would most likely result in the highest rate of natural selection?
(a) Reproduction by asexual method
(b) Low mutation is an stable environment
(c) Little competition
(d) Reproduction by sexual method

Ans : **OD 2016**

Reproduction by sexual methods brings the change in progeny. In sexually genes reproduced organisms, the independent assortment of genes and genetic recombination takes place. Due to these events, the progeny have high rate of natural selection than the asexually reproduced organisms.
Thus (d) is correct option.

39. According to Darwin, the organic evolution is due to
(a) intraspecific competition
(b) interspecific competition
(c) competition within closely related species
(d) reduced feeding efficiency in one species due to the presence of interfering species

Ans : **DELHI 2012**

Darwin stated that the organic evolution is due to the interspecific competition. It is the competition between members of different species. Intra-specific competition occurs amongst members of the same species for obtaining optimum amounts of their food, shelter, mate, water, light, etc.
Thus (b) is correct option.

40. Darwinian fitness can be estimated by
(a) how long different individual in a population survive
(b) number of offspring produced by different individuals in population
(c) individual have a large size in population
(d) species recover after mass extinction

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Ans : **COMP 2017**

Darwinian fitness can be estimated by the number of offspring produced by different individual in a population. The organisms which have favourable variation in accordance with environment have more offspring than the other which don't have variations in accordance with environment.
Thus (b) is correct option.

41. Which of the following factor was not taken into account by Darwin in his theory of natural selection?
(a) Struggle for existence
(b) Discontinuous variations
(c) Parasites and predators as natural enemies
(d) Survival of the fittest

Ans : **SQP 2007**

Natural selection theory of Darwin did not believe in any role of discontinuous variation. Darwin called these variations as sports, while Hugo de Vries used the term nutation for these variations. These variations are sudden heritable changes, which can occur in any stage of development.
Thus (b) is correct option.

42. Which of the following statements would Darwinism most likely disagree with?
(a) Individuals within a population vary in the characteristics they possess
(b) Evolution is best viewed as a purpose less and non-directional change over time

(c) The Assertion is correct but Reason is incorrect.

(d) Both the Assertion and Reason are incorrect.

Ans : **SQP 2021**

The human gestation period cannot be shortened unless there is really a problem. Complete development will not take place days in humans.
Thus (d) is correct option.

70. Assertion : Human ancestors never used their tails and so the tail expressing gene has disappeared in them.
Reason : Lamarck's theory of evolution is popularly called theory of continuity of germ plasm.

(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) The Assertion is correct but Reason is incorrect.

(d) Both the Assertion and Reason are incorrect.

Ans : **COMP 2005**

According to Lamarck's theory, continuous disuse of organs makes them weak. The theory of continuity of germplasm was given by Weismann.

If humans share ancestry with other primates such as prosimian, monkeys etc. then remnants of that common ancestory should be present in our genes.
Thus (c) is correct option.

71. Assertion : Darwin's finches show a veriety of beaks suited for eating large seeds, flying insects and cactus seeds.
Reason : Ancestral seed-eating stock of Darwin's finches radiated out from South American mainland to different geographical areas of the Galapagos Islands, where they found competitor-free new habitats.

(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) The Assertion is correct but Reason is incorrect.

(d) Both the Assertion and Reason are incorrect.

Ans : **OD 2009**

Darwin finches found on Galapagos islands differ primarily in body size, feather colour, bill shape as adaptation to type of food available. It is a type of divergent evolution.
Thus (a) is correct option.

72. Assertion : The earliest organisms that appeared on the earth were non-green and presumable anaerobes.
Reason : The first autotrophic organisms were the chemoatutotrophs that never released oxygen.

(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) The Assertion is correct but Reason is incorrect.

(d) Both the Assertion and Reason are incorrect.

Ans : **DELHI 2005**

The earliest organisms that appeared on the earth were heterotrophic because of reducing atmosphere and the first autotrophs were chemoautotrophs.

An anaerobic organism does not require oxygen for growth and may even die in its presence. Chemotrophs are the first organisms that appeared on earth and obtain energy by the oxidation of electron donating molecules in their environments. These molecules can be organic (organotrophs) or inorganic (lithotrophs). The chemotrophs utilize solar energy and can be either autotrophic or heterotrophic.
Thus (b) is correct option.

73. Assertion : The earliest fossil form in the phylogeny of horse in eohippus.
Reason : Eohippus lived during the early pliocene epoch.

(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) The Assertion is correct but Reason is incorrect.

(d) Both the Assertion and Reason are incorrect.

Ans : **FOREIGN 2010**

Eohippus is the earliest fossil form in the phylogeny of horse. Origin of horse took place in the eocene period. The first fossil of horse was found in North America which was named Eohippus or "Dawn Horse.", that later renamed as hyracotherium.

It was found during eocene period not during pliocene.
Thus (c) is correct option.

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50. In which epoch, only modern humans prevails?
(a) pleiostocene (b) Holocene
(c) Pliocene (d) Miocene

Ans : DELHI 2020

In the quaternary period there were two epochs
1. **Holocene** It includes only moderns humans.
2. **Pleiostocene** It includes ice age and various human species.

Thus (b) is correct option.

51. There was no life in
(a) Cenozoic era (b) Mesozoic era
(c) Palaeozoic era (d) Azoic era

Ans : SQP 2023

Azoic means no life. It was the era which prevailed during the origin of earth. At that time there was no hostile condition for the survival of any living organisms.
Thus (d) is correct option.

52. The Cenozoic era is often designated as
(a) age of fish
(b) age of reptiles
(c) age of mammals
(d) age of amphibians

Ans : FOREIGN 2022

Cenozoic era is also called the age of mammals. In this era the first mammal was originated on.
Thus (c) is correct option.

53. Which of the following is an extinct animal?
(a) Protopterus (b) Equus
(c) Archaeopteryx (d) Columba

Ans : COMP 2006

Archaeopteryx (Archlae-primitive; pteryx wing). It was found in the rocks of Jurassic period. It was discovered by Andreas Wagnar in 1861. It displays both the characters of reptiles and birds.
Thus (c) is correct option.

54. Correct order of evolutionary scale is
(a) Palaeozoic → Archaeozoic → Cenozoic
(b) Archaeozoic → Palaeozoic → Proterozoic
(c) Palaleozoic → Mesozoic → Cenozoic
(d) Mesozoic → Archaeozoic → Proterozoic

Ans : OD 2010

Azoic era → Proterozoic era → Paleozoic era → Mesozoic era → Cenozoic era (recent)
Thus (c) is correct option.

55. What was the most significant trend in the evolution of modern man (Homo sapiens) from his ancestors?
(a) Shortening of jaws
(b) Binocular vision
(c) Increasing brain capacity
(d) Upright posture

Ans : SQP 2018

The most significant trend in the evolution of modern man is the increased brain capacity from the ancestors. The first human being was the hominid, called Homo habilis. The brain capacities were between 650-800 cc.
Thus (c) is correct option.

56. The extinct human who lived 100000 to 40000 years ago, in Europe, Asia and parts of Africa, with short stature, heavy eye brows, retreating fore heads, large jaws with heavy teeth, stocky bodies, a lumbering gait and stooped posture was
(a) Homo habilis
(b) Neanderthal human
(c) Cro-magnon humans
(d) Ramapithecus

Ans : FOREIGN 2016

Neanderthal man with a brain size of 1400cc lived in near East and Central Asia, Europe and North Africa between 100000 to 40000 years back. It had slightly prognathous face, sloping forehead, eye brow ridges, smaller or no chin, large receding jaws, thick-boned skull and high domed head. They used hides to protect their body and buried their dead.
Thus (b) is correct option.

57. Choose the incorrect pair
(a) Ramapithecus- Man-like
(b) Dryopithecus- Ape-like
(c) fossil of man-like bones were discovered- Ethopia and Tanzania
(d) Australopithecus- Probably lived in Western Africa desert

Ans : DELHI 2009

Two mya, Australopithecus probably lived in Eastern African grassland.
Thus (d) is correct option.

58. Homo sapiens most likely arose in
(a) India (b) America
(c) England (d) Africa

Ans : COMP 2017

Homo sapiens arose in Africa and moved across continents and developed into deistinct races. During ice-age between 7000-10000 years ago,

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VERY SHORT ANSWER QUESTIONS

78. Define evolutionary biology.

Ans : COMP 2005

The study of history of life is called evolutionary biology.

79. Theory of special creation was promoted by which scientist?

Ans : SQP 2016

Lazzaro Spallanzani.

80. Apart from homologous and analogous organs, which other organs can be used as evidences for organic evolution?

Ans : FOREIGN 2011

Vestigial organs, e.g. tail bone in human babies.

81. What is Big Bang theory?

Ans : COMP 2016

Big Bang theory states that our earth originated as a result of cataclysmic evolution.

82. State the significance of study of fossils in evolution.

Ans : DELHI 2012

Fossils help us to know the geological period in which the organisms were present to understand the process of the evolution.

83. The first cellular life form originated when and where?

Ans : OD 2009

2000 million years ago, in aquatic environment.

84. Name any two vertebrate's body parts that are homologous to human forelimbs (hands).

Ans : DELHI 2017

Flippers of whales and forelimbs of cheetah.

85. Why are analogous structures a result of convergent evolution?

Ans : All India 2014

When organisms of different geographical location come into an area, i.e. they converge to the restricted habitat, they develop adaptations to that location and develop analogous structures.

86. Attempt giving a clear definition of the term species.

Ans : SQP 2020

A group of organisms capable of interbreeding and producing fertile offspring is called species.

87. What role does an individual organism play as per Darwin's theory of natural selection?

Ans : DELHI 2017

According to Darwin, the organisms which are better fit or adapt well survive in nature.

88. State the significance of biochemical similarities among diverse organisms in evolution.

Ans : DELHI 2012

Similarities in biochemicals such as DNA help in deriving the line of evolution. Organisms with more similar DNA sequences are considered close relatives or have evolved from the same ancestor.

89. Name the placental mammals corresponding to the Australian spotted cuscus and Tasmanian tiger cat, which have evolved as a result of convergent evolution.

Ans : All India 2008C

Australian spotted cuscus-Lemur.
Tasmanian tiger cat-Bob cat.

90. How many years back were the following developed in human evolution?

(i) Cave art

(ii) Agriculture

Ans : FOREIGN 2009

(i) Cave art : 18000 years ago
(ii) Agriculture : 10000 years ago

91. Identify the period which is called age of reptiles.

Ans : COMP 2007

Jurassic period.

92. Write the probable differences in eating habits of Homo habilis and Homo erectus.

Ans : All India 2016

The probable differences in eating habit of Homo habilis and Homo erectus are as following
Homo habilis They did not eat meat.
Homo erectus They probably ate meat.

93. What do you mean by panspermia?

Ans : OD 2013

Panspermia refers to spores.

94. Explain the meaning of 'survival of the fittest'.

Ans : DELHI 2015

The ability to survive and to reproduce in their respective environment is termed as survival of the fittest.

95. What is 'fitness of an individual' according to Darwin?

Ans : DELHI 2017

According to Darwin, fitness of an individual is its ability to reproduce successfully and leave a

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large number of progenies under a particular set of selection pressures.

96. State the reason for the increased population of dark coloured moths coinciding with the loss of lichens (on tree barks) during industrialisation period in England.

Ans : DELHI 2015

During post-industrilisation period, the tree trunks got dark because of industrial smoke and soot, so the dark coloured moths were able to hide without any risk of predation, survived and increased in population. White winged moths did not survive due to predators.

97. Write down the consequence of absence of genetic variations among individual of a population.

Ans : SQP 2014

There will be no organic evolution will occur in such a population.

98. According to Hugo de Vries what is saltation?

Ans : All India 2016

According to Hugo de Vries mutation that causes speciation is saltation.

99. Define gene migration.

Ans : FOREIGN 2016

The process of addition of new genes to new population and removal from old population resulting in change of frequency.

100. What is founder effect?

Ans : COMP 2022

It refers to random gene frequency which occurs by chance where original drifted population becomes the founder and this effect is founder effect.

101. What was the unique event in the history of universe?

Ans : OD 2019

Origin of life is considered a unique event in history of universe.

102. The theory of spontaneous generation was dismissed by whom and why?

Ans : DELHI 2012

Louis Pasteur rejected the theory of spontaneous generation and stated that life originates from pre-existing life.

103. When did bryophytes appeared on the earth?

Ans : SQP 2014

Bryophytes were the first plant to be appeared on earth.

104. Hugo de Vries gave the mutation theory. Name the plant he worked on.

Ans : FOREIGN 2019

Primrose plant (Oenothera lamarckiana),

105. How can you say lobefins were ancestors of evolution?

Ans : COMP 2017

Lobefins were ancestors of evolution as their discovery evolved amphibians and fish-like organisms.

106. The 'origin of species' was given by which scientist?

Ans : COMP 2005

Charles Darwin

107. What did the first mammal look like.

Ans : OD 2016

First mammal looked like shrew.

SHORT ANSWER QUESTIONS

108. What is gene mutation? What is its role in organic evolution?

Ans : OD 2018

The change in the sequence of nucleotide (addition, deletion, substitution or inversion) resulting in alteration in structure and expression of gene is turned as, gene mutation or point mutation.

Such mutations are evolutionarily important as they bring genetic variability among the population of an species. This can be useful for the organism to adjust in the new environmental conditions and eventually leading to origin of new species.

109. Write about sequential evolution.

Ans : OD 2018

Evolution at its simplest involves relatively minor changes in the gene pool of population from one generation to the next with corresponding modification in genotypic frequencies and range of phenotypic variation. Though, no new populations result from the change, but at same time the descendent population is also not genetically same as its predecessor. Thus, evolution of modified gene pools from pre-existing ones is called sequential evolution. The characteristic feature of this type of evolution are as follows.

1. It produces random changes or fluctuations over long period of time, with relatively little difference between the genotypic combinations and frequencies.

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2. This type of evolution never produces new population from old one by itself. It produce only temporal temporary changes in a population continuum.
3. The changes are non-directional.

110. Write in brief about chemical evolution.

Ans : **OD 2015**

Chemical evolution describes chemical changes on the primitive earth that gave rise to the first forms of life. The first living things on earth were prokaryotes with a type of cell similar to present-day bacteria. All forms of life are theorized to have evolved from the original prokaryotes, probably 3.5-4.0 billion years ago.

In 1957, Stanley Miller and Harold Urey provided laboratory evidence for chemical evolution. Miller and Urey created an apparatus that simulated the primitive environment. They used a warmed flask of water for the ocean, and an atmosphere to water, hydrogen, ammonia and methane. Sparks discharged into the artificial atmosphere represented lightning. A condenser cooled the atmosphere, causing rain that returned water and dissolved compounds back to the simulated sea. When Miller and Urey analysed the components of the solution after a week, they found various organic compounds had formed. These included some of the amino acids that compose the proteins of living things. Their results gave credence to the idea that simple substances in the warm primordial seas gave rise to the chemical building blocks of organisms.

Free atoms H,C,N,O, etc.

↓

Formation of molecules and simple inorganic compounds H_2, NH_3, H_2O, etc.

↓

Formation of early organic compounds CH_4, HCN, etc.

Formation of simple organic compounds sugar. fatty acid, purines, pyrimidines, amino acids, glyceroids, etc.

↓

Formation of complex organic compounds polysaccharide proteins, facts, nucleotides, nucleic, acids, etc.

111. Write in brief how disease spreads.

Ans : **OD 2015**

Many pathogens require a living host to survive, while others may be able to persist in a dormant state outside of a living host. Means of transmission of infectious diseases may be of two main types:

Direct transmission-

1. Contact with infected person (e.g., AIDS).
2. Contact with soil (e.g., Tetanus).
3. Animal bites (e.g., Rabies).
4. Transplacental (e.g., Syphilis, AIDS).

Indirect transmission :

1. Through vectors (e.g., Malaria).
2. Through contaminated food and water (e.g., Hepatitis).
3. Air transmitted diseases (e.g., common cold, pneumonia).

112. What is Geological time scale? It is classified into eras. Name the eras.

Ans : **OD 2014**

Geological time scale is a table showing the sequence of geological periods in the history of earth. It also shows the lengths of time different geological periods are assumed to have occupied. It is measured in millions of years. It has been constructed by studying rock strata, where these have been exposed by excavations or mining or where rivers have cut deeply into the earth's crust. The geological time scale is divided into five main eras: Coenozoic, Mesozoic, paleozoic, Proterozoic and Archezoic. Each era is divided into periods and each period is divided into epochs.

A geological era is very long division of geological time, lasting tens of millions of years. Its beginning and end are recognized by major changes in layers of rocks and fossils in the earth.

113. Find out from newspapers and popular science articles any new fossil discoveries or controversies about evolution.

Ans : **COMP 2009**

1. Fossils provide evidence for organic evolution.
2. Recently, two fossils were discovered from China which ignited a controversy over the evolution of birds.
3. One such genus of primitive birds is confuciusornis, which was crow-sized and lived during cretaceous period in China.

114. Try to trace the various components of human evolution.
(Hint: brain size and function, skeletal structure, dietary preference, etc.)

Ans : **DELHI 2011**

Human evolution

1. Dryopithecus and Ramapithecus lived about 15 million years ago; they were hairy and walked like apes.

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results in the addition of new alleles to the local gene pool of the host population. This is called gene migration. Migration causes variations at the genetic level.

2. **Genetic drift :** The random changes in gene frequency in a population occurring by chance alone rather than by natural selection is called genetic drift. The effects of genetic drift are more prominent in small populations.

166. What was the contribution of Lamarck for the evolution of life forms?

Ans : **OD 2023**

Lamarck a French naturalist has said that evolution of life forms had occurred but driven by use and disuse of organs. For example, giraffes who in an attempt to forage leaves on tall trees had to stretch their bodies, forelimbs and their necks. The process continued for several generations. As time passed, this acquired character of elongated neck passed to succeeding generations. Giraffes slowly over the years, came to acquire long forelimbs and long necks.

167. What were Darwin views on his visit to Galapagos Islands?

Ans : **DELHI 2014**

In Galapagos islands, Darwin observed amazing diversity of creatures. A small black bird called finches amazed him. He realised that there were 13 species of finches which differed from each other as well as from mainland finches in their size, beaks and food habits within the same island. All the varieties he found evolved on the island itself from the original seed eating features, Many other forms with altered beaks arose, enabling them to become insectivorous and vegetarian finches. This process of evolution is regarded as adaptive radiation.

168. What is the essence of Darwinism theory about evolution?

Ans : **SQP 2011**

The essence of Darwinism theory about evolution is natural selection which is based on useful inheritable variations that help in more reproduction and leave more progeny. The rate of appearance of new forms is linked to the life cycle or lifespan. Microbes that divide fast have the ability to multiply and become millions of individuals within hours, have lot of variations and the useful variation helps in adapting to ever changing environment, may be the presence of DDT.

169. What do you mean by evolution by anthropogenic action?

Ans : **FOREIGN 2013**

Anthropogenic action tells us that evolution is not a direct process in the sense of determinism. It is a stochastic process (analysed statistically but not predicted precisely) based on chance events in nature and chance mutation in the organisms. Example of evolution by anthropogenic action excess use of herbicides, pesticides etc. by man has only resulted in selection of resistant varieties in a much less time scale. This is also applicable for microbes, against which we use antibiotics or drugs against eukaryotic organisms/cell. Hence, by the action of man resistant organisms/cells have evolved in a time scale of months or years and not centuries.

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170. Attempt giving a clear definition of the term species.

Ans : **COMP 2015**

A species is a group of similar individuals differing from the members of other species, which interbreed freely to produce fertile offspring, are relatively stable and yet are sufficiently flexible and plastic that they tend to change in the course of many generations.

171. What is divergent evolution? Explain taking an example of plants.

Ans : **OD 2010**

The same structure developed along different directions due to adaptations to different needs. This is divergent evolution and these structures are known as homologous organs.

In plants also, thorn and tendrils of Bougainvillea and cucurbita represent homology. Both are modified stem structures as evident from their axillary position. Homology is based on divergent evolution whereas analogy refers to a situation exactly opposite.

LONG ANSWER QUESTIONS

172. What is adaptive radiation? Illustrate it giving suitable example.

Ans : **OD 2018**

Adaptive radiation is the process of evolution of different species in a given geographical area in which different members of same ancestral species are evolved along different lines in different habitats of same area. It is a process in which organisms diversify rapidly from an ancestral species into a multitude of new forms, particularly

2. Human evolution is not the case of adaptive radiation as it is a gradual and step by step process, which took place slowly over time.
3. In contrast to adaptive radiation, the process of human evolution is known as anagenesis.

120. Using various resources such as your school library or the internet and discussions with your teacher, trace the evolutionary stages of any one animal, say horse.

Ans : **DELHI 2011**

Evolution of Horse :

1. The ancestor of the horse that lived in Eocene epoch, was Eohippus.
2. It evolved into mesohippus (oligocene), Merichippus (Miocene), Pliohippus and Equus.
3. The modern day horse (Pleiocene) is Equus.
4. The major evolutionary changes included :
   (a) Lengthening of limbs.
   (b) Progressive reduction in the number of toes and lengthening of the remaining toes.
   (c) General increase in the body size.
   (d) Enlargement of brain.

121. What does the Big Bang theory explain to us?

Ans : **SQP 2005**

The Big Bang theory attempts to explain to us the origin of universe. It tells us of a singular huge thermonuclear explosion in a highly condensed super hot cosmic matter. Hydrogen and helium formed sometime later. The gases condensed under gravitation and formed the galaxies of the present day universe.

122. When was the earth formed? What was its conditions at that time?

Ans : **FOREIGN 2006**

The earth was supposed to have been formed 4.5 billion years ago. At that time, there was no atmosphere on the earth. Water vapour, methane, carbon-dioxide and ammonia released from molten mass covered the surface.

123. Name the different theories of origin of life.

Ans : **COMP 2010**

Theories of Origin of life :

1. Theory of special creation.
2. Theory of Spontaneous generation (Abiogenesis or autogenesis).
3. Theory of Extra terrestrial or cosmic origin (Panspermia).
4. Theory of Biogenesis (Modern theory or Oparin-Haldane Theory of origin of life).

124. Why are theories of special creation and spontaneous generation stand rejected?

Ans : **OD 2012**

Special creation theory is purely a religious theory and is not based on any scientific fact. It fails to explain biological phenomena and does not enjoy acceptance by most of the literate people.

Spontaneous theory cannot be accepted because it was experimentally challenged by **Redi, Spallanzani** and **Louis Pasteur**. They established that life is always formed from pre-existing life. They disapproved abiogenesis and proved biogenesis.

125. What was the contribution of Oparin of Russia and Haldane of England regarding evolution?

Ans : **DELHI 2014**

Both Oparin of Russia and Haldane of England proposed that the first form of life could have originated upon our earth spontaneously from non-living organic molecules (e.g., RNA, protein etc.). Thus, formation of life was preceded by chemical evolution i.e., formation of diverse organic molecules from inorganic constituents which evolved from inorganic compounds, under special environmental conditions prevalent at that time upon the earth.

126. Define theory of biogenesis. Who were the scientists to support this theory experimentally?

Ans : **SQP 2005**

According to this theory, life originated from pre-existing life Omne vivume vivo. Living beings are neither produced spontaneously nor created. This theory was developed by **Francisco Redi** (1621-1697), which was subsequently supported by many scientists, including **Spallanzani** (1729-1799) and **Louis Pasteur** (1822-1895). It does not explain the origin of life.

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127. Describe the mechanism of evolution as explained by Hugo de Vries.

Ans : **FOREIGN 2015**

Hugo de Vries worked on evening primrose and put forward the idea of mutations- large difference arising suddenly in population. He believed mutations cause evolution and not the minor heritable continuous variations as proposed by Darwin. Evolution for Darwin was gradual while de Vries believed that mutation caused species formation and hence known as Saltation (Single step large mutation). Thus, evolution is a jerky process.

128. Write the similarity between the wing of a butterfly and the wing of a bat. What do you infer from the above with reference to evolution?

Ans : **DELHI 2023**

Wing of a butterfly and the wing of a bat; are the anatomically different structures, though they look alike and have evolved for the same function and hence having similarity. These structures are called analogous structures and are a result of convergent evolution (presence of similar adaptive features in different groups of organisms but towards the same function).

129. Describe the cosmozoic theory of origin of life. What are its drawbacks?

Ans : **SQP 2014**

According to this theory primitive life or Panspermia in the form of spores, micro-organisms etc. came to the earth from some heavenly body through meteorites (Richter 1865). However the possibility of some living beings coming from some other planet seems to be highly remote because of (i) Distance involved (ii) Absence of life on nearby planets (iii) Presence of lethal radiations in the interstellar space (iv) Presence of very high temperature in outer part of atmosphere (v) Unable to explain origin of life.

130. In England, before industrialization set in, there were more white winged moths than dark winged moths. However, the number reversed in the same area when industrialization set in. How does this observation support natural selection?

Or

How does industrial melanism support Darwin's theory of Natural Selection? Explain.

Ans : **COMP 2019**

In England, 1850s before industrialisation, there were more white-winged moths on trees than dark-winged or melanic forms. White moths survived by hiding among thick growth of white coloured lichens and the dark coloured moths were picked by predators.

But after industrialisation there were more dark coloured moths in the same area i.e., the proportion was reversed. Dark coloured moths survived because tree trunks became dark due to smoke and soot. Lichens disappeared due to pollution by industrialisation and white-coloured moths did not survive due to predators. This showed that in a mixed population, those that can better adapt, survive and increase in population size.

131. What are coacervates?

Ans : **OD 2017**

The term coacervates was used by I. A. Oparin (1923). The cluster of organic molecular aggregates in colloidal form which are bounded by a membrane, grow by absorbing molecules from environment and divide by budding are termed coacervates.

132. Write a short note on the impact of origin of photosynthesis.

Ans : **FOREIGN 2018**

Impact of Origin of Photosynthesis.

(i) It introduced a mechanism of regular inflow of energy in the biosphere.

(ii) It developed an alternate method of formation of organic matter when the original organic molecules were coming to an end.

(iii) Photosynthesis provided far more rapid formation of organic matter and hence development of other methods of nutrition.

(iv) It evolved oxygen that made the atmosphere oxidising.

133. Identify the examples of convergent evolution from the following:

1. Flippers of penguins and dolphins
2. Eyes of octopus and mammals
3. Vertebrate brains

Ans : **SQP 2005**

Analogous structures are different structures evolving for the same function and hence having similarity, are the result of convergent evolution.

1. Flippers of penguins (wing modified) and dolphin (forearm modified), both help in swimming.
2. The eyes of octopus and mammals perform the same function i.e. photoreception. They are similar in position. However, the entire eyes of octopus (a mollusc) develop from the skin while in mammals (vertebrate) the retina of eye develops from embryonic brain.

134. How does palaeontological evidence support evolution of organisms on Earth?

Ans : **COMP 2010**

Different aged rock sediments contain fossil of different types. Early rocks contain fossils of simple organisms while recent rocks contain fossils of complex organisms, e.g. dinosaur.

By studying fossils occurring in different strata of rocks, geologists are able to reconstruct the geological period in which they existed and the

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course of evolutionary change. Hence, new forms of life originated at different times in the history of earth.

135. Who proposed the term evolution? What is evolution? List the different evidences in support of evolution.

Ans : **DELHI 2009**

The term organic evolution was proposed by Charles Darwin. It signifies as **Decent with modification** which states that present complex forms of life have evolved from earlier simpler forms of life by accumulation of gradual changes. According to organic evolution, unicellular organisms evolved into simple, multicellular organisms like invertebrates which in turn evolved into complex multicellular chordate organisms like the fishes. The fishes evolved into amphibians which gradually changed into reptiles from which birds and mammals have evolved into amphibians which gradually changed into reptiles from which birds and mammals have evolved along different lines. In this way, numerous varieties of living organisms have been produced over millions of years.

Types of Evidences:

1. Palaeontological evidences
2. Morphological and anatomical evidences
3. Bio-geographical evidences
4. Embryological evidences
5. Taxonomical evidences
6. Physiological and biochemistry evidences
7. Cytological evidences
8. Genetical evidences

136. What are homologous organs? Give an example.

Ans : **SQP 2023**

The organs of different organisms of a group have different forms and perform different functions but their origin and internal structures basically remains similar. Such organs are called homologous organs. **Example:** The wings of bird and bat, flipper (fin) of whale, human forearms are different in forms because these have to perform different functions.

137. Comment on the similarity between the wing of a cockroach and the wing of a bird. What do you infer from the above, with reference to evolution?

Ans : **OD 2007**

The wing of a cockroach and the wing of a bird show similarity only in the function. The different structures evolving for the same function are analogous structures and are a result of convergent evolution.

138. **Sweet potato tubers and potato tubers are the result of convergent evolution.** Justify the statement.

Ans : **FOREIGN 2021**

Some organisms have organs which have similar function but they are different in anatomical structural details and origin. These organs are called analogous structures They are as a result of convergent evolution sweet potato tubers (underground, modified adventitious roots) and potato tubers (underground, modified stem branches) are both fleshy and serve the function of storage of food materials.

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139. What are analogous organs? Give two examples.

Ans : **COMP 2011**

The organs which are similar in appearance and perform the same function but differ in their fundamental structure and origin are called analogous organs.

Examples:

1. Wings of birds and insects.
2. Leaves of aplant and cladodes (stem-modified leaves) of Ruscus are also analogous organs.

140. Explain homology and analogy.

Ans : **OD 2013**

Homology is based on divergent evolution where same structure evolve different forms to perform different functions though their internal structure and origin is similar.

Analogy refers to a situation exactly opposite. For example, wings of butterfly and of birds look alike. They are not anatomically similar structures though perform similar functions. Analogous structures are a result of convergent evolution-different structures evolving for the same function and thus, having similarity.

141. What are vestigial organs? Give examples.

Ans : **SQP 2005**

Vestigial organs are small reduced functionless organs in an organism which are fully developed were functional in related animals and were functional in the ancestors. There are 80 vestigial organs in the human body and mainly include coccyx (tail bone); nictitating membrane (3rd eyelid); caecum and vermiform appendix; canines; wisdom teeth; body hair; auricular muscles; mammary glands in male etc. Vestigial organs are also present in some other animals e.g., splint bones in horse; hindimbs and pelvic girdles in python; wings and feathers in flightless birds etc. Scale leaves, staminodes and pistillodes are the

1. **Chemical evolution :** Organic molecules were formed from inorganic molecules (CH_4, H_2, NH_3, Water vapours) under special conditions i.e., high temperature, energy from electric discharges and high energy radiations.
2. **Organic/Biological evolution :** It involves origin of first-form of life from pre-existing non-living organic molecules, about 2000 million years ago.

155. Enlist the main points of Darwin's Theory of Evolution.

Ans : **FOREIGN 2005**

Darwin's Theory of Evolution can be summed up as follows:

1. Rapid multiplication or Prodigality.
2. Struggle for existence (Intraspecific, interspecific and environmental).
3. Variations (Selective advantage of useful variations).
4. Natural selection or survival of the fittest by Herbert Spencer.
5. Inheritance of useful variations.
6. Formation of new species.

156. Differentiate between Lamarckism and Darwinism.

Ans : **DELHI 2009**

The difference between Lamarckism and Darwinism are as follows :

	Lamarckism	**Darwinism**
1.	It believes in the presence of an internal vital force in all organisms.	It does not believe in the existence of any internal vital force.
2.	Modifications and even new organs can develop due to new needs, desires and conscious reaction.	They do not form part of theory of natural selection by Darwin.
3.	Use and disuse of organs brings about their development and degeneration respectively	An organ can develop further or degenerate only due to variations appearing in that direction.
4.	Change in environment produces variations.	Variations are already present. Changing environment selects some useful variations suitable for it.
5.	It does not consider any struggle for existence.	Struggle for existence is very important part of this theory.
6.	All the acquired variatins are transferred to the next generation.	Only the useful variations are inherited to the next generation.
7.	It does not believe in natural selection.	The theory is based on natural selection and survival of the fittest.

157. Differentiate between Darwinism and Neo-Darwinism.

Ans : **OD 2010**

The difference between Darwinism and Neo-Darwinism are as follows :

	Darwinism	**Modern synthetic theory**
1.	Darwinism does not give reason for the appearance of variations.	It explains the origin of various types of variations.
2.	It believes that all useful variations are inheritable.	It believes that only genetic variations are inheritable.
3.	Individuals are believed to be units for evolution.	Unit of evolution is a population.
4.	Natural selection operates through survival of the fittest.	Natural selection operates through differential reproduction.
5.	It does not give importance to isolation.	Isolation is pre-requisite for formation of new species.

158. What are the main features of mutation theory?

Ans : **FOREIGN 2019**

The various features are as follow:

1. Mutations are raw material for evolution.
2. Sudden variations appear all of a sudden.
3. Recurring-Appear in more than one individual at same time as well as different times.
4. No intermediate form.
5. Express their effect at once.
6. Inheritable in nature.

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organism during its development repeats in abbreviated form the evolutionary history of its race. However, Haeckel believed that development stages of an embryo shows development stage of its ancestral adults. It is not true. An embryo recapitulates the embryonic stages of its ancestors and not the evolutionary stages of its adults. The frog during its development passes through a fish-like tadpole stage which shows that it descended from a fish-like ancestor.

148. Identify the examples of homologous structure from the following:
Thorns in Bougainvillea and tendrils of Cucurbita.
Ans : **OD 2007**

Thorns in Bougainvillea and tendrils of cucurbita are homologous structures. Both the structures are stem modified. Thorns protect the plant from browsing animals and reduce transpiration while tendrils help the weak-stemmed plant in climbing. They represent homology. Homology is based on divergent evolution.

149. Is evolution a process or the result of a process?
Ans : **FOREIGN 2009**

When we describe the story of this world we describe evolution as a process. On the other hand, when we describe the story of life on earth, we treat evolution as a consequence of a process called natural selection. We are still not very clear whether to regard evolution and natural selection as processes or end result of unknown processes.

150. Name the various theories of evolution.
Ans : **SQP 2013**

There are four theories of evolution.

1. Lamarck's theory of inheritance of acquired characters of Lamarckism.
2. Darwin's theory of Natural selection or Darwinism.
3. De Vries Mutation theory.
4. Modern synthetic theory of evolution.

151. What is Lamarckism? List the main points of the theory.
Ans : **FOREIGN 2005**

Jean Baptist Lamarck (1744-1829), a French biologist published his book philosophic Zoologique in 1809 giving the first theory of evolution. Lamarck theory is called the theory of inheritance of acquired characters, through the use and disuse of organs, it is also termed as Lamarckism.
Main points of theory:

1. Internal vital force.
2. Perfecting principle (fitness of design).
3. Effect of changed environment.
4. New needs or desires (Doctrine of desires of appetency).
5. Effect of use and disuse of organs.
6. Isolation and inheritance of acquired characters.
7. The origin of new species.

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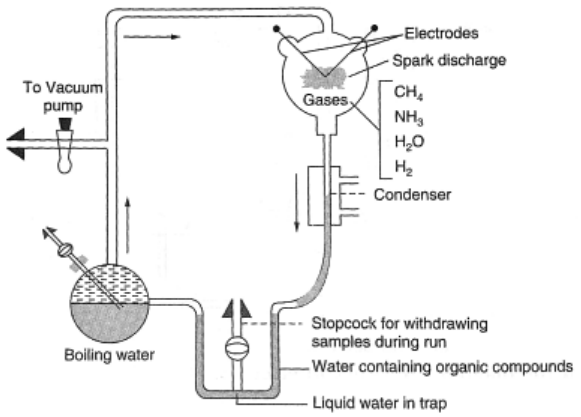
152. Name the main critic of Lamarck. Mention the name of his theory.
Ans : **COMP 2015**

A German Biologist, August Weismann (1834-1914) was the main critic of Lamarck. He proposed the theory **The continuity of germplasm.** He cut the tail of mice for 21 generations. There was no difference in the length of the tail in the offspring of 22nd generation as compared to the tail length in the parents of first generation.

153. Mention the contribution of S. L. Miller's experiment on Origin of Life.
Ans : **DELHI 2019**



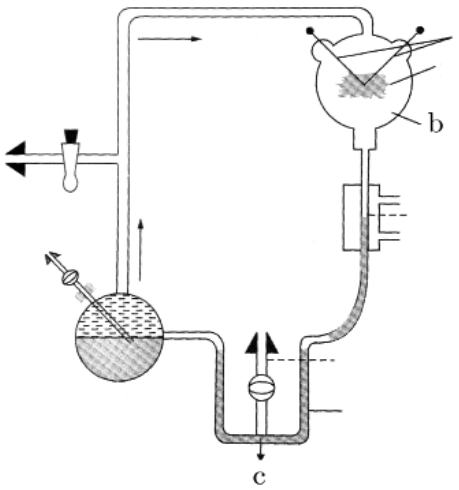
Methane, ammonia, etc. forming the reducing atmosphere changed into simple organic compounds such as sugars, bases, amino acids, glycerol, fatty acids, etc.
Stanley Miller 1953, created similarconditions in a laboratory and passed eletric discharges in a closed flask containing CH_4, H_2, NH_3, water vapours at 800°C and obnserved formation of amino acids. Sugar, bases, pigments and fats were also observed. The formation of organic molecules from inorganic molecules is chemical evolution.

154. List the two main propositions of Oparin and Haldane.
Ans : **COMP 2005**

The two main propositions of Oparin and Haldane are :

vestigial organs of plants. They became useless to possessor due to alternate development.

142. The figure given below represents Miller's apparatus used for his experiment. Name the scientist who had used the set-up shown below. Name the chemicals found in the samples drawn from **c**. How did this experiment support evolution?



Ans : **FOREIGN 2005**

Name of the scientist: Stanley Miller 1953. Amino acids, (other scientist observed formation sugars, bases pigments and fats) were the chemicals found in the samples drawn from C.

Miller experiment supports chemical evolution i.e., the formation of organic molecules from inorganic molecules.

143. Define connecting link. Give some examples and significance.

Ans : **DELHI 2016**

These are living intermediate forms which possess characters of two groups. They indicate the evolution of one form from another because in them the characteristics of both the groups are represented. For example, platypus, lungfishes, oviparous mammals. These animals are called connecting links.

Examples of connecting links:

1. Chimaera (rabbit-fish) between cartilage and bony fishes.
2. Peripatus (Walking worm), between annelids and arthropods.
3. Coelcanth between bony fishes and amphibians.
4. Neopilina between annelids and molluscs.
5. Lungfish between bony fishes and amphibians.
6. Platypus and spiny anteater between reptiles and mammals.

Significance. Connecting links prove the process and path of evolution and lie midway between two groups. Such organisms indicate transitional forms (unfinished forms) of organic evolution.

144. Discuss molecular homology as a evidence of organic evolution.

Ans : **SQP 2013**

Similarities of organisms at molecular level is called molecular homology e.g. Proteins found in the blood of man and apes are similar. The phylogeny of an organism can be traced by using the base sequence in nucleic acids and amino acid sequence of proteins in related organisms.

145. What is a missing link? Give the significance of Archaeopteryx in the study of organic evolution.

Ans : **FOREIGN 2008**

Missing links are fossil organisms having characters of two different groups. The best example of missing link is afforded by a fossil bird, Archaeopteryx had both reptilian and avian characters.

It was the size of a crow. Archaeopteryx is decidedly a bird as it has feathers and a beak. But like reptiles it has a long tail, jaws full of teeth, claws on forefingers and keel-less sternum. Thus, it represents a stage in the evolution of birds from reptiles through Archaeopteryx like intermediate form.

146. How does embryology support organic evolution?

Ans : **COMP 2010**

The comparative study of the embryology of different animal groups shows striking structural similarities between them. The aspects of embryology which lend support to the doctrine of organic evolution are

(i) Similar early development.

(ii) Resemblance among vertebrate embryos.

(iii) Recapitulation theory.

(iv) Temporary, non-functional embryonic structures.

(v) Development of vertebrate organs.

147. Explain briefly Recapitulation theory.

Or

State and explain Haeckel's Biogenetic law.

Ans : **FOREIGN 2005**

This theory was put forward by Von Baer (1828) and Haeckel called it biogenetic law. It states that ontogeny repeats phylogeny i.e., that every

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7. Natural selection of useful mutations.
8. New species originate suddenly due to large mutation or formed by accumulation of small mutations.
9. Discontinuous evolution, not a gradual process, but jerky.

159. Describe Hugo de Vries Mutation theory.

Ans : **SQP 2020**

Hugo de Vries (1848-1935) was a Dutch Botanist. He performed experiments on the Evening Primrose (Oenothera lamarckiana). He observed new inheritable variations that were not connected with the normal character of the species by any intermediates.

According to this theory, new species arise suddenly showing abrupt deviations in characters from the normal forms. Thus, evolution is not a slow and gradual process but a sudden discontinuous and jerky process.

160. Define differential reproduction?

Ans : **OD 2024, COMP 2015**

All individuals of a species reproduce to produce offspring. It has been observed that only few of the off-springs are able to survive to reach adulthood and rest perish. Those which become adults and reproduce again with varying degrees of success; some produce many off-springs, some only a few and some produced none. This is referred to as and some produced none. This is referred to as and some produced none. This is referred to as and some produced none. This is referred to as differential reproduction.

161. What is reproductive isolation? Give its significance.

Ans : **SQP 2013**

Prevention of mating between two natural populations of the same or different species due to the presence of barriers to interbreeding is called reproductive isolation. The various barriers to interbreeding or gene exchange are called isolating mechanisms.

Signigicance : (i) It prevents inbreeding of natural populations present in the same geographical locality (sympatric populations). (ii) Essential for the formation of new species. (iii) Maintaining the distinct identity of different species.

162. What data support that evolutionary history of man is like that of any other organism?

Ans : **COMP 2008**

It is a true and confirmed fact that evolutionary history of man is similar to that of any other organism. Following points support it.

1. Evolution is from simple to complex.
2. Evidences from fossils:
   (a) The genera Ramapithecus and Shivapithecus lived in Africa and Asia 14-15 mya were the forerunners of Hominids (erect posture, bipedal locomotion).
   (b) A genus, Australopithecus appeared in Africa about 5 mya and had a brain measuring 350-450 cm^3.
   (c) Genus Homo evolved about 2 mya.
3. Evidences from molecular studies: Similarities in the sequence of blood proteins and nucleic acids indicate relationship with apes.
4. Evidences from Chromosomal studies: The banding pattern in chromosomal study of man and apes confirm the ancestral relationship between the two.
5. Evidence from Haemoglobin.

163. Write a short note on Cro-magnon man.

Ans : **OD 2006**

The early fossil of a modern man is called cro-magnon man and he emerged 34000 years. He is the extinct, most recent direct ancestor of present day living man. He was 1.8 metres tall with sturdy body and brain capacity as large as in living man. He had high forehead, prominent chin and inconspicuous brow ridge. He developed superior culture, made sophisticated excellent tools. He lived in families in caves. A number of cave paintings done by cro-magnon man have been discovered.

164. Write a short note on Homo habilis.

Ans : **DELHI 2016**

1. About 1.2 - 1.5 metres tall, first human like Hominid
2. Bipedal locomotion.
3. Moved erect and omnivorous.
4. Cranial capacity 700 cc.
5. Teeth like that of modern man.
6. First toolmaker and used tool of chipped stones.
7. Led community life in caves and greatly cared for young ones.

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165. How is genetic drift different from gene migration? Explain.

Ans : **FOREIGN 2020**

1. **Gene migration :** The movement of a section of population from one place to another,

2. 3-4 million years before, man-like primates walked in Eastern Africa; they were about four feet tall and walked upright.
3. Australopithecines lived about two million years before in East African grasslands; they hunted with stone weapons but basically ate fruits.
4. Hono habilis succeeded Australopithecines; they had brain capacities of 650-800 cc and probably did not eat meat.
5. Homo erectus lived about 1.5 million years ago; they had a large brain of about 900 cc and they probably ate meat.
6. Neanderthal men (Homo sapiens) lived in Central and East Asia between 100,000-40,000 years before; they had a brain capacity of 1400 cc.
7. During the ice age, i.e. 75,000-10,000 years ago, modern man (Homo sapiens) arose and moved across the globe.

115. Explain antibiotic resistance observed in bacteria in light of Darwinian selection theory.

Ans : **SQP 2005**

1. The rate of appearance of new forms (species) is linked to the life span of a species; shorter the lifespan, faster will be the appearance of new forms and vice versa.
2. A colony of bacteria, growing on a given medium has in-built variation in terms of the ability to withstand a chemical (antibiotic) in the medium.
3. A change in the composition of the medium would allow only those bacteria to grow which can survive under the new conditions, i.e., in the presence of antibiotics.
4. In course of time, the variant population outgrows the others in population size and becomes a new species.
5. This would happen within a week, as bacteria have a generation time of only 20 minutes.

116. Find out through internet and popular science articles whether animals other than man has self-consciousness.

Ans : **SQP 2014**

Many animals other than human have self-consciousness. For example, dolphins are highly intelligent. They have a sense of self and they also recognise others among themselves. They can communicate with each other by whistles tail slapping, and other body movements. Besides dolphins some other animals such as parrots, chimpanzees, orangutans, gorilla, etc also have self-consciousness.

117. List 10 modern-day animals and using the internet resources link it to a corresponding ancient fossil. Name both.

Ans : **FOREIGN 2016**

Modern-day animals and their corresponding ancient fossil are given in the table:

S. No.	Animal	Corresponding ancient fossil
1.	Man	Ramapithecus
2.	Horse	Eohippus
3.	Dog	Leptocyon
4.	Camel	Protylopus
5.	Fish	Arandaspis
6.	Whale	Protocetus
7.	Elephant	Moerithers
8.	Bat	Archaeonycteris
9.	Tetrapod	Icthyostega
10.	Giraffe	Palaeotragus

118. Describe one example of adaptive radiation.

Ans : **OD 2017**

1. Adaptive radiation is the process of evolution of different species in a given geographical area, starting from a point and literally radiating to other geographical areas or habitats.
2. Darwin's finches are an example of adaptive radiation.
3. There were many varieties of small black birds in the Galapagos Islands, which are known as Darwin's finches.
4. Darwin reasoned that after originating from a common seed-eating stock, the finches must have radiated to different geographical locations in the same island and undergone adaptive changes, especially in the type of beak, enabling them to be insectivorous or vegetarian finches.
5. Living in isolation for long, the new kinds of finches emerged that could survive and function in the new habitats.

119. Can we call human evolution as adaptive radiation?

Ans : **SQP 2005**

1. Adaptive radiation is a phenomenon of evolution of different species in a geographical area, starting from a point and literally spreading to other habitats.

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when a change in the environment makes new resources available, creates new challenges, or opens new environmental niches. Starting with a recent single ancestor, this process results in the speciation and phenotypic adaptation of an array of species exhibiting different morphological and physiological traits.

One of the most famous examples of adaptive radiation was observed by Charles Darwin, and documented in his book On the Origin of Species. Upon visiting the Galapagos Island, Darwin noted that each of the islands had a resident population of finches belonging to the same taxonomic family. However, the bird populations on each island differed from those on nearby islands in the shape and size of their beaks. Darwin suggested that each of the bird species had originally belonged to a single common ancestor species, which had undergone modifications of its features based on the type of food sources available on each island. For example, the birds that fed on seeds and nuts evolved large crushing beaks, while cactus eaters developed longer beaks, and finer breaks evolved in birds that fed by picking insects out of trees.

When the ancestral from of finches initially colonized each island, each group contained individuals who were able to better adapt to the conditions and the available food source. These individuals survived and reproduced in their new habitat. In doing so, the genes that controlled for certain favorable aspects (e.g., longer beaks suitable for accessing nectar deep inside flowers) were spread throughout the gene pool, while the individuals without favoured features died out. This is the process of natural selection.

173. Describe the origin and evolution of human beings.

Ans : **OD 2014**

The formation of complex organisms through gradual change from simple ancestral type over the course of geological time is called as evolution. The emergence of modern human being from primitive ancestor (primates) is termed as human evolution. The beginning of primates evolution is assumed to be in Eocene of Tertiary period in evergreen forests. They later in Oligocene returned to the ground from trees due to replacement of evergreen forests to dried savanna- grassland. Thus, the evolution of apes and man started together from tree dwelling common ancestors approximately 25-30 million years ago.

The place of origin of human is matter of controversy. It could have probably occurred in Central Asia, China, Java and India (Shivalik hills).

The common ancestor of apes and human is a primate Dryopithecus, that lived 15 million years ago. The next stage in the hominid evolution in Ramapithecus. After this further stages of human evolution is as follows:-

1. **Australopithecus :** They had a brain capacity of 450-600 cc. They were about four feet tall and walked nearly upright. They hunted with stone weapons but ate fruits. Their fossiles were found in Tanzania and Ethiopia.
2. **Homo habilis :** They lived in East African grasslands. They had a brain capacity of 650-800 cc.
3. **Homo erectus :** Their fossils were found in Java. They had a brain capacity of about 900 cc.
4. **Homo sapiens :** Their fossils were found in East ans Central Asia. Their brain capacity was about 1400 cc. They must lived between 100000-40000 years before. They used hides to protect the body and also buried the body after death. They became extinct about 25000 years before.
5. **Homo sapiens :** They arose during the ice age between 75000-10000 years ago and learned to cultivate plants and domesticate animals. Agriculture started around 10000 years back after that Human settlement and civilisation started.

174. Explain evolution with the help of its embryological evidences.

Ans : **OD 2013**

Evolution is the process of origin of new and more complex organisms from the pre existing simpler forms through gradual modification. It is a very slow process. No human being can see how evolution takes place but, its occurrence is supported directly or indirectly by many kinds of evidences. One of them is Embryology. It is branch of biology that deals with the study of prenatal development of embryo or foetus. It provides following evidence in support of evolution.

1. **Similarity in early development of animals :** All animals start their life cycle as a zygote develops to form morula, blastula and gastrula. The gastrula shows three germ layers-Ectoderm, mesoderm and endoderm. These germinal layers also develop to form same types of parts in all animals.
2. **Similarity in vertebrate embryos :** The embryos of fishes, amphibians, reptiles, aves and mammals resemble closely in the early

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have been studied by palaeontologists. The best amongst them is fossil history of horse, followed by camel and elephant.

180. What is geological time scale? Discuss geological timescale as evidence of evolution.

Ans : **DELHI 2023**

Geological time scale can be defined as a correlation between time periods of past and fossiliferous rocks.

First geological time scale was proposed by Italian scientist Ardino (1760). It is estimated that age of Fossils provide the best evidences in support of evolution. Different types of organisms occurred on earth during different ages. There is a progression evolution from earlier forms to later forms.

Our planet earth is about 4.6×10^6 years and first life originated in water (probably seas) about 3.6×10^6 years ago. Geological time scale is the tabulated form showing the sequence and duration of the eras and the periods with their dominant form of life since the beginning of life on earth.

In the geological time scale, the duration of earth's history has been divided as follows:

Era	Periods
Palaeozoic	**6 Periods.** They are: Cambrian, Ordovician, Silurian, Devonian, Carboniferous and Permian.
Mesozoic	**3 Periods.** They are Triassic, Jurassic and Cretaceous.
Coenozoic	**2 Periods.** Tertiary and Quaternary. Some of the periods are further divided into still smaller time spans called epochs.
Tertiary Period	**5 epochs.** Palaeocene, Eocene, Oligocene, Miocene and Pilocene.
Quaternary	**2 epochs.** Pleistofcene and Recent.

181. State the theory of Biogenesis. How does Miller's experiment support this theory?

Ans : **FOREIGN 2005**

According to theory of biogenesis as proposed by Oparin and Haldane life first originated from pre-existing non-living organic molecules. Organic molecules were formed from inorganic molecules under the special conditions, i.e., high temperature, volcanic storms, energy from electric discharges, and high energy radiations, prevailing on the earth at that time.

Methane, ammonia forming the reducing atmosphere changed into simple organic compounds such as sugars, bases, amino acids, glycerol, fatty acids, etc.

Stanley Miller 1953, created similar conditions in a laboratory and passed electricdischarges in a closed flask containing CH_4, H_2, NH_3, water vapours at $800^\circ C$ and observed formation of amino acids. Sugars, nitrogen bases, pigments and fats were also observed. The formation of organic molecules from inorganic molecules is chemical evolution.

Simple organic molecules formed complex organic compounds by polymerisation.

Organic molecules aggregated to form protobionts also called coacervates, 3 billion years back. Coacervates would have been giant molecules of RNA, proteins and polysaccharides etc. They produced a lipid bilayer and termed as microsphere and started reproducing their molecules.

First cellular form of life originated about 2000 million years ago. They were single-cell heterotrophs.

First simple cellular forms evolved into present day complex diversity by a process called Evolution. this is biological or organic evolution.

182. How does the process of natural selection affect Hardy-Weinberg equilibrium? Explain. List the other four factors that disturb the equilibrium.

Ans : **FOREIGN 2011**

Natural selection refers to the fitness of the individual or population. Those organisms which are better fit in an environment out-breed others and leave more progeny than others in natural conditions. These, therefore, survive more and hence are selected by nature.

Types of natural selection : Operation of natural selection on different traits is of three types:

1. **Stabilising :** more individuals acquire mean character value.
2. **Directional :** more individuals acquire value other than the mean character value.
3. **Disruptive :** more individuals acquire peripheral character value at both ends of distribution curve.

The other four factors that disturb the genetic equilibrium are:

(a) **Gene flow/ migration :** The movement of a section of population from one place to another, results in the addition of new alleles to the local gene pool of the host population. This is called gene migration. Migration causes variations at the genetic level.

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177. How did Hardy-Weinberg explain that allelic frequencies in a population are stable and are constant from generation to generation?

Ans :

Hardy-Weinberg proposed equilibrium principle. It describes a theoretical situation, in which population is undergoing no change and are stable and constant from generation to generation. Hardy-Weinberg principle is applicable only under the following conditions:

(a) **No Mutation :** There should not be either gene or chromosomal mutation.

(b) **No Gene Migration :** There must be no exchange of genes (gene flow) between the populations. All genes must have an equal chance of being passed to next generation.

(c) **No Genetic Drift :** The population must be very large. Genetic drift refers to a change in the population of alleles in the gene pool. So genetic drift must not occur.

(d) **No Random Mating :** The population must reproduce sexually and mating must be random.

(e) **No Natural Selection Pressure :** There must be no natural selection pressure with respect to the alleles in question.

According to Hardy-Weinberg equilibrium Principle, gene frequencies will remain constant if all above five conditions are met.

Constant gene frequencies over several generations indicate that evolution is not taking place.

178. What is speciation? Explain the role of natural selection in speciation with the help of suitable example.

Ans : **FOREIGN 2005**

The phenomenon of development of a new species from pre-existing one is called speciation. Natural selection is one of the major factor which has played a great role in speciation. Natural selection includes that the organisms which are provided with favourable variations would survive, because they are fittest to face their surroundings while the unfity are destroyed i.e. the survival of the fittest the phrase used by Herbert Spencer and Natural Selection by Darwin.

To explain the role of natural selection, example of Industrial Melanism can be considered. Before Industrialisation, there were more white-winged moths on tree than dark-winged moths. The white-winged moths could hide themselves, among the white-coloured lichen covering the tree trunks. Dark-winged moths were at disadvantage. They could be easily spotted by predators, hence very less in number.

After industralization, tree trunks became dark due to industrial smoke. Under such conditions, the white-winged moths did not survive due to predators and dark-winged moths survived and increased in number. Therefore moths that were hidden in the background survived. Thus industrial melanism supports speciation by natural selection.

179. Describe the various evidences from palaeontology which support organic evolution.

Ans : **SQP 2012**

The evidences are as follow :

1. **Early Fossils :** Fossils of earliest life are scanty and only prokaryotic. Later on eukaryotic developed-algae and early invertebrates. Higher forms were absent.
2. **Disparity between fossils :** Present day organisms seem to be related to the fossils of quaternary period but differ from those of tertiary period. Fossils of quaternary period are similarly related to tertiary period but differ from the ones of cretaceous period. These differences are due to changes in form, structure and habits of organisms due to evolution.
3. **Extinct organisms :** Number of organisms existed on earth for sometime and then disappeared. They include dinosaurs, toothed birds, pteridosperms, giant horsetails, ancestors of man etc. Extinction occurred due to many factors. Some of the extinct forms have left their modified descendents (Man, modern day Horse) while others have perished without it (Pteridosperm, Dinosaurs).
4. **Distribution of fossils :** Early fossils were fewer and of simple organisms. Complexity and increase in number occurred with passage of time.
5. **Missing Links :** Transitional or intermediate forms between two groups of organisms which occur only in the fossil state e.g., Seymouria, missing link between amphibia and reptilia.
6. **Plant vs Animal Fossils :** Animals of the past have left more fossils as compared to plants evidently due to the presence of slow decaying harder structures in their exoskeleton and endoskeleton.
7. **Fossil history of individual organisms :** Fossil histories of some plants and animals

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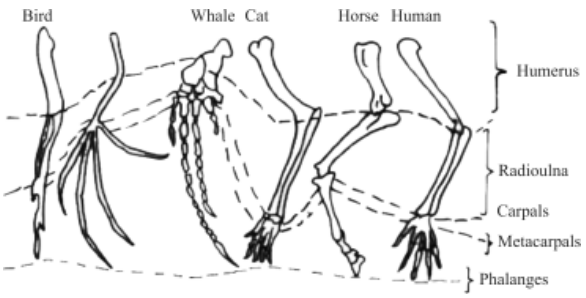
stages. In fact it is difficult to distinguish them. Show presence of similar head with rudiments of eyes and ears. Possess pharyngeal clefts, notochord and embryonic tail. Notochord is replaced by vertebral column in all vertebrate embryos.

3. **Temporary embryonic structures :** Embryos of certain animals possess temporary non functional strendwess that disappear or reduce before birth. Examples-gill clefts are seen in embryos of all land vertebrates that is not present in adult. Toothbuds are present in embryos of toothless whales and birds, embryos of all vertebrates have notochord which is replaced by vertebral column is adults.
4. **Recapitulation theory :** This was proposed by Von Baear, and revised and renamed Biogenetic Law by Ernst Haeckel. This states that "Ontogeny repeats phylogeny", an organism during its embryonic development repeats in an abbreviated from the evolutionary history of an individual. Example-Development of frog: The tadpote show fish-like characters, gills, tail with tail-fin and lateral line.

175. What are homologous and analogous organs? Explain by giving examples.

Ans : **OD 2012**

Homologous Organs are the organs which are similar in structure and origin but may look very different and perform different functions. Forelimbs of vertebrates are good example of homologous organs. They are built on the same fundamental plant yet they appear different and perform different functions. In each case the forelimb consists-of humerus, radius and ulna, carpals, metacarpals and phalanges. This basic similarity in the structure of the apparently different forelimbs of different kinds of vertebrates is due to the fact that all these limbs have evolved from a common type called the pentadactyl (five-fingered) limb. The homologous organs, therefore, prove that different kinds of organisms came into existence through evolution.



Analogous organs The structures which are functionally similar but structurally different are called analogous organs. The wing of an insect, and that of a bird or bat pterodactyl are examples of analogous organs. The funciton of the wing is the same (for flying) but the insect wing has no structural resemblance with that of the vertebrates.

(a) Wing of insect (b) Wing of bird

176. Write an essay on Darwinism.

Ans : **OD 2010**

Darwinism is a theory of biological evolution developed by the English scientist Charles Darwin. It is also called as Darwin's theory of Natural selection or Darwin's theory of survival of fittest. It states that all species of organisms arise and develop through the natural selection of small, inherited variations that increase the individuals ability to complete, survive and reproduce. He describes his theory in his book origin of species by means of Natural selection in 1859. The main postulates of this theory are as follows.

1. Enormous Fertility and Overproduction: To ensure continuity of race, organisms produce large number of offspring.
2. Struggle for Existence: The large number of individuals of all the species living together in the same area complete for same resources.
3. Survival of the Fittest: Certain members are able to capture the resources better than others. They are more successful in the struggle for existence and produce more offspring. This is called survival of the fittest.
4. Variations and Heredity: The new characters or new combinations of characters that arise due to heredity make living organisms different and better adapted to their environment.
5. Natural Selection and Origin of Species: Organisms with more advantageous traits are able to produce more offspring. These advantageous traits accumulate in the population generation after generation. Since in different environments, natural selection favours accumulation of different variations, gene pools of sister populations of a species become markedly different. This leads to origin of new species.

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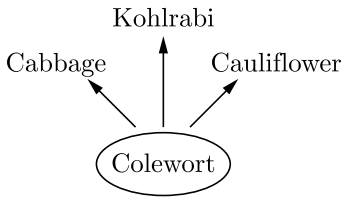
(b) **Genetic drift :** The random changes in gene frequency in a population occurring by chance alone rather than by natural selection is called genetic drift. The effects of genetic drift are more prominent in small populations.

(c) **Mutation :** Pre-existing advantageous mutations when selected, result in new phenotypes and over few generations would result in speciation.

(d) **Recombination :** Variations due to recombination during gametogenesis result in changed frequency of genes and alleles in future generation. Reproduction increases the variants and natural selection, makes it different population.

183. What is artificial selection? How man has employed to obtain new varieties of plants and animals?

Ans : **2022**



There is a close parallelism between natural selection and artificial selection. Artificial selection is done by man exactly in the same way as nature does. The criteria for selections are based on human needs and requirements. In breeding experiments, man selects useful animals with desired traits and separates them from those which do not possess such traits. After repeating this process for a few generations a new breed of animals is formed. In this way, man has been able to produce several varieties of domesticated animals like cows, horses, sheep, dogs etc., from their wild ancestors. Other examples of organisms produced by man through artificial selection are kohlrabi, cabbage, cauliflower, all these are obtained from common ancestor, colewort.

Different breeds of pigeons have been obtained from wild Rock Pigeon through artificial selection. If man can produce new varieties of breeds in a short period of time, nature with its vast resources and very long time at its disposal can easily produce new species by selection.

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184. Write the Oparin and Haldane's hypothesis about the origin of life on Earth. How does meteorite analysis favour this hypothesis?

Ans : **COMP 2006**

Theory of Chemical Evolution and Biological Evolution proposed by Oparin and Haldane.

First form of life, originated from pre-existing non-living organic molecules. Under the special conditions, i.e., high temperature, volcanic storms, energy from electric discharges, and high energy radiations, prevailing on the earth at that time.

Methane, ammonia, etc. forming the reducing atmosphere changed into simple organic compounds such as sugars, bases, amino acids, glycerol, fatty acids, etc.

Meteorites analysis favours the theory of Oparin & Haldane. Meteorites have been reported to contain organic substances, e.g. Murray (USA), Murchinson (Australia). Murchinson meteorite of Australia has been found to contain a number of laevorotatory amino acids as are found in living organisms.

185. With the help of any two suitable examples explain the effect of anthropogenic actions on organic evolution.

Ans : **FOREIGN 2005**

Pesticide resistance and antibiotic resistance are very good examples of evolution by anthropogenic (man) action.

1. **Pesticide Resistance :** DDT was discovered by Muller (1939). It was found to be highly effective against mosquitoes, flies and insects, causing malaria, sleeping sickness and crop pests in general. However, after about two decades, this was found to be ineffective against most pests. New pesticides were used but after a lapse of a few years, the pests were found to develop resistance against them as well. At present same 400 insect pests are known to possess resistance against most pesticides. Therefore, newer pesticides are entering market every year for effectively controlling the pests.
2. **Antibiotic Resistance :** When first discovered, penicillin was widely used as an antibiotic against bacterial pathogens. Soon it was found to be ineffective against many bacteria. Reduction in effectiveness of antibiotic is naturally due to development of resistance against it. The antibiotic kills the pathogens and successfully treats most patients. However, some patients will show relapse of disease after initial success. It is because

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the two types of our acquired immune response - antibody mediated. The second type is called cell-mediated immune response or cell-mediated immunity (CMI). The T-lymphocytes mediate CMI. Grafts from just any source - an animal, another primate, or any human beings cannot be made since the grafts would be rejected sooner or later. Tissue matching, blood group matching are essential before undertaking any graft/transplant and even after this the patient has to take immuno-suppresants all his/her life. The body is able to differentiate 'self' and 'nonself and the cell-mediated immune response is responsible for the graft rejection.

(i) What type of response mediated by antibodies?

(ii) Which cell is responsible for cell mediated immunity?

(iii) Which molecules are most responsible for rejection of transplant?

(iv) Which immunoglobulin does constitute the largest percentage in human milk?

Ans :

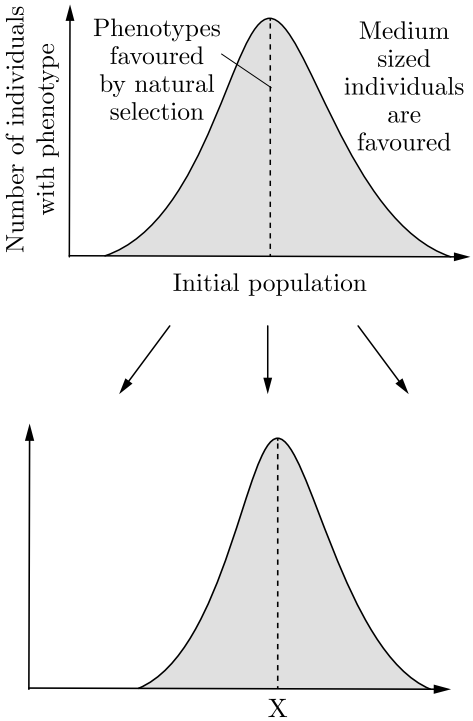
(i) Humoral immune response

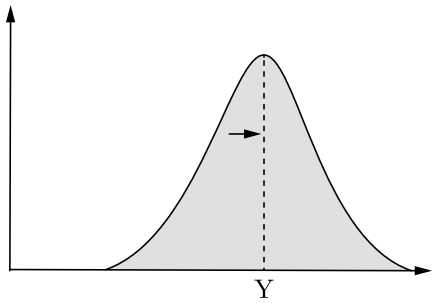
(ii) Cytotoxic-T cell

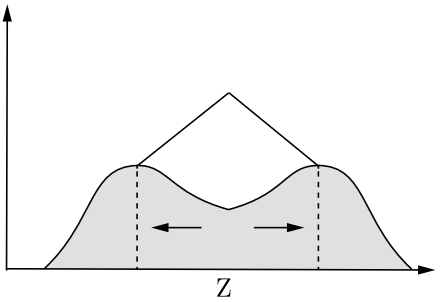
(iii) T-lymphocytes (cells)

(iv) IgA

193. Natural selection can influence distribution of phenotype in three different ways as shown below in the figure. On the basis of this figure answer the questions that follow.







(i) On the basis of the given graphs, what conclusion can you draw about case X and Y?

(ii) What is the significance of higher and narrower peak in case X?

(iii) What does graph in case Y indicates? Give suitable example.

(iv) What would happen if population is converted into case Z?

Ans :

(i) Case X shows the stabilising and case Y shows the directional change caused due to natural selection of different traits in a population.

(ii) When peak gets higher and narrower as in case X, then it shows stabilising type caused due to natural selection in population in which medium sized individuals are favoured.

(iii) In case Y, the graph shows the directional selection in which an extreme phenotype is favoured over other phenotype. E.g., length of giraffe neck.

(iv) The graph of case Z shows the disruptive selection in which two extreme phenotypes are favoured over the intermediate phenotype.

194. Charles Darwin made a sea voyage around the world between the year 1831-1836 a sail ship Hars Beagle. During that period Darwin explored the fauna and flora of a number of continents and islands.

(i) What does "the fitness of the individual refers to according the Darwin.

(ii) What were the two key concept of Darwinian theory of evolution.

(iii) Give any two examples of Natural Selection.

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190. How does the shift in Hardy-Weinberg equilibrium lead to founder effect?

Ans : **FOREIGN 2008**

Five factors are known to affect Hardy-Weinberg equilibrium. These are gene migration or gene flow, genetic drift, mutation, genetic recombination and natural selection. When a section of population migrates to another place, gene frequencies change in the original as well as in the new population. New genes/alleles are added to the new population and these are lost from the old population. There would be gene flow if this gene migration happens many times. If the same change occurs by chance it is called genetic drift. Sometimes the change in allele frequency is so different in the new sample of population that they become a different species. The original drifted population becomes founders and the effect is called founder effect. The important example of founder effect is genetic drift in human population where a group of person called founders leave their home, for new settlement having a population of different genotype frequencies from that of parent population. Formation of different genotype in new settlement is called founder effect.

CASE BASED QUESTIONS

191. In an experiment to know the genotype of a red flowered plant it was crossed with a homozygous white flowered plant. The progenies obtained were of two types as shown below in the figure.

Parents :	Red flowered plant with unknown genotype	×	White flowered homozygous plant (rr)
F_1 :	Red flowered plants		White flowered plants
Phenotypic ratio :	1	:	1

Based on the above information, answer the following questions:

(i) On the basis of this cross, what conclusion can you draw?

(ii) What is the significance of the cross described above?

(iii) What would be the genotype of red and white flowered plants in F_1 if Allele R/r is responsible for the this trait ?

(iv) What would be the probability of homozygous and heterozygous plants in F_1 progeny?

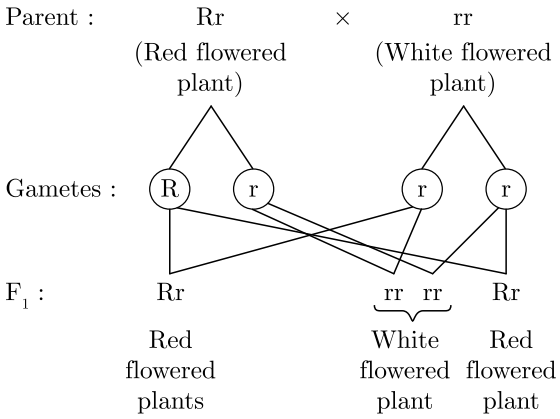
Ans :

(i) The given cross depicts the test cross.

(ii) Test cross is performed to determine the genotype of plants.

(iii) Genotype of red flowered plants in F_1 generation will be Rr and genotype of white flowered plants in F_1 generation will be rr.

(iv) As phenotypic ratio obtained in F_1 is 1 : 1, it means red flowered parent plant will be heterozygous with Rr genotype. The genotype of white flowered parent plant will be rr. The cross between them can be represented as follows:



In F_1, red flowered plants are heterozygous which constitute 50% of the progeny. White flowered plants are homozygous which also constitute 50% of the progeny.

192. Acquired immunity, on the other hand, is pathogen specific. It is characterised by memory. This means that our body when it encounters a pathogen for the first time produces a response called primary response which is of low intensity. Subsequent encounter with the same pathogen elicits a highly intensified secondary or anamnestic response. This is ascribed to the fact that our body appears to have memory of the first encounter. The primary and secondary immune responses are carried out with the help of two special types of lymphocytes present in our blood, i.e., B-lymphocytes and T- lymphocytes. The B-lymphocytes produce an army of proteins in response to pathogens into our blood to fight with them. These proteins are called antibodies. The T-cells themselves do not secrete antibodies but help B cells produce them. Each antibody molecule has four peptide chains, two small called light chains and two longer called heavy chains. Hence, an antibody is represented as H_2L_2. Different types of antibodies are produced in our body. IgA, IgM, IgE, IgG are some of them. Because these antibodies are found in the blood, the response is also called as humoral immune response. This is one of

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CHAPTER 7

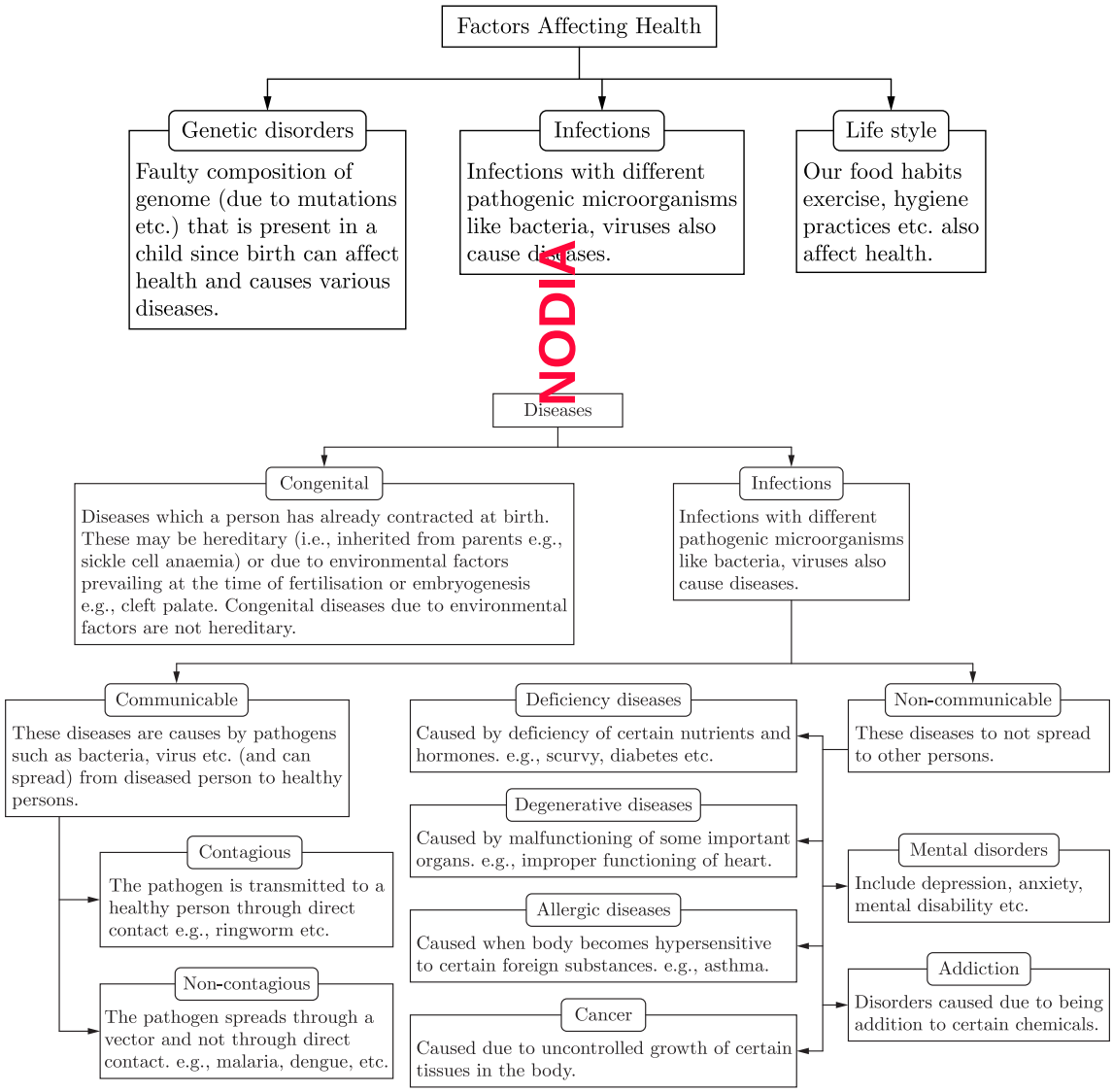
HUMAN HEALTH AND DISEASES

SUMMARY

1. HEALTH

Health is defined as a state of complete physical, mental and social well being and not merely the absence of disease or infirmity. Good health is a state of optimum physical fitness, mental maturity and alertness with freedom from anxiety and social well being with freedom from social tensions.

When the functioning of one or more organs or systems of the body is adversely affected, characterised by various signs and symptoms, we say that we are not healthy, i.e., we have a disease.



Ans :

(i) According to Darwin, the fitness of the individual refers to the repreductive fitness. Such fit individuals leaues more progeny them others.

(ii) (a) Branching descent
(b) Natural Selection

(iii) (a) Industrial Melanism
(b) Chemical Resistance

195. Mutations introduces the new genes into a species resulting in change in gene frequencies :
In 1908, GH Hardy and W Weinberg established a simple mathematical relationship to study these gene frequencies and gave Hardy-Weinberg principle.

(i) $p^2 + 2pq + q^2 = 1$ is called ..... ?

(ii) List the factors that affects Hardy-Weinberg equilibrium.

(iii) How many types of effects are there in natural selection ?

Ans :

(i) The above equation is called binomial expansion.

(ii) The certain factors that effect Hardy-Weinberg equilibrium are gene migration, Genetic drift, Mutation, Genetic recombination, Natureal selection.

(iii) The natural selection can have following three effects i.e., stabilization, directional change, discruption.

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antibiotic kills most of the bacteria which are sensitive. A few with resistance survive. They multiply and cause relapse.

186. Explain with an example evolution by natural selection.

Ans : **OD 2020**

In 1850 in England in a collection of moths before industrialisation it was observed that there were more white winged peppered moths on trees than dark wings or melanised moths. White moths could hide among the similarly coloured lichens. However, after industrialisation there were more dark winged moths in the same area i.e., the proportion was reversed. The reason for this way that during post-industrialisation period the tree trunks became dark due to industrial smoke and soots resulting in disapperance of lichens. Under these conditions the white-winged moths became conspicous, did not survive due to predators and the dark winged or melanised moths survived.

Before industrialisation, thick growth of white-coloured lichen covered the trees-in that background the white-winged moths survived but the dark-coloured moths were picked out by predators. Hence, moths that were able to comouflage themselves i.e., hide in the background survived.

Now, due to the control on emission of soot particles and gases, lichens along with white peppered moths are again appearing. It is reverse evolution.

187. Write a short note on fossil formation. Are the fossils being formed at present time?

Ans : **DELHI 2018**

Fossilization of dead organisms or their parts usually begins when they are buried before they have a chance to decay. The organisms sink into a resin or bog or a marsh or to the bottom of a lake, sea or river. In some cases they are buried by wind driven sands. Even after burial decay can occur so that soft body parts decompose, a fact which emphasizes again that the hard parts are the ones that most commonly persist as fossil. The buried parts that do not decay are preserved and as mud or sand hardens to rock, the fossil becomes entombed.

Yes, if the dead bodies of the organisms, are buried and escape decay. Fossilization is a hit or miss effect. Only those organisms become fossilized that happen to die in a spot where they can be buried by natural process before their carcasses are destroyed by scavengers. Thus, under such conditions fossils are being formed at the present time.

188. Define the terms

1. Palaeontology 2. Phylogeny 3. Fossils.

Ans : **SQP 2013**

1. **Palaeontology :** It is the study of fossils. The fossils are the remains or impressions of ancient animals and plants preserved in rocks. Palaeontology provides the most direct evidence for evolution as it deals with the actual organisms of the past. Palaeontological evidences have also enabled us to trace the phylogenetic history of many animals.
2. **Phylogeny :** The study of evolutionary history of an organism is called phylogeny. It states that how an animal in its development from egg to adult repeats the various stages through which its ancestor has passed. Ernst Haeckel proposed the biogenetic law which states that ontogeny repeats phylogeny.
3. **Fossils :** The remains or impressions of the organisms from the remote past can be called as a fossil. By examining the various layers of earth from the deepest to the most superficial strata for fossil record, the story of life in correct historical sequence i.e., geological timescale can be known.

189. Draw a schematic representation of evolution of man.

Ans : **COMP 2012**

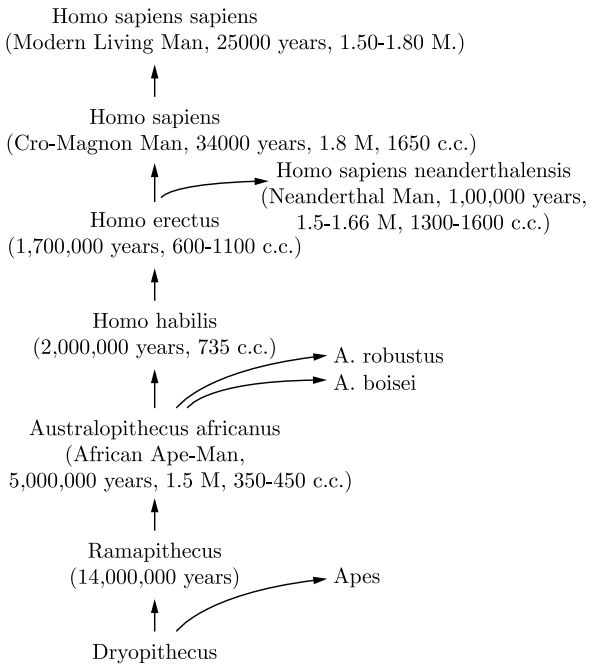

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Table : Communicable Human Diseases

Disease	Pathogen	Transmission	Symptoms	Treatment
Bacterial diseases				
Typhoid	Salmonella typhi	Faecal oral route	High fever, weakness, abdominal pain, constipation, and loss of appetite.	Antibiotics such as terramycin and chloromycetin are effective against the bacteria.
Pneumonia	Strepto-coccus pneumoniae pneumoniae and /H	The disease spreads through sputum of the patient	Single shaking chill, followed by fever, pain with breathing on the side of lung increased pulse and respiratory rates and cough.	Drugs against pneumonia are penicillin streptomycin and ampicillin.
Dysentery	Shigella dysenteriae	Faecal oral route	An infection of the intestinal tract causing severe diarrhoea with blood and mucus.	
Bubonic plague (Black death)	Pasteurella/Yersinia pestis	Transmitted by the bite of infected rat flea Xenopsylla cheopis.	High fever, bubo in groin or armpit	Antiplague vaccine available
Diphtheria	Corynebac-terium diptheriae	Droplet infection	Development of a grey adherent false membrane over the upper respiratory tract or throat.	DPT vaccine available.
Viral diseases				
Common cold/Rhinitis	Rhnoviruses	Droplets form cough or sneezes of an infected person are either inhaled directly or transmitted through contaminat-ed objects and infect healthy person.	Virus infects nose and upper respiratory passage (but not the lungs) causing inflammation of mucous membranes. There is nasal congestion, flow of mucus, sore throat, cough, headache and slight fever.	It is cured automatically after 3-7 days. Antigistam-ines and decongestants are used as drugs to relieve from symptoms.
Polio	Enterovirus	Virus enters the body via faecal-oral route and reaches the nervous system through blood stream	Inflamma-tion of nervous system, paralysis with high fever, headache, chilliness, pain all over the body	Oral polio vaccine, Salk vaccine.
Chikun -gunya	Chikungunya virus	By bite of Aedes aegypti mosquito	Sudden onset of fever, crippling joint pains, lymphod-enopathy and conjuctivities	Paracetamol and aspirin

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38. To which type of barriers under innate immunity, do the saliva in the mouth and the tears from the eyes, belong?
(a) Physical barriers
(b) Cytokine barriers
(c) Cellular barriers
(d) Physiological barriers

Ans : DELHI 2007

The examples of physiological barriers are hydrochloric acid in stomach, saliva in mouth, lysozyme in tears, saliva, etc.
Thus (d) is correct option.

39. Which one of the following acts as a physiological barriers to the entry of micro organisms in human body?
(a) Skin
(b) Epithelium of urogenital tract
(c) Tears
(d) monocytes

Ans : SQP 2008

The examples of physiological barriers are hydrochloric acid in stomach, saliva in mouth,lysozyme in tears, saliva, etc.
Thus (c) is correct option.

40. Immunoglobulins are
(a) antigen (b) antibodies
(c) antiseptics (d) antibiotics

Ans : DELHI 2005

Immunoglobulins (Ig), also known as antibodies, is a large Y-shape protein. It is produced by plasma cells and used by the immune system to identify and neutralize foreign objects such as bacteria and virus. The antibody recognized a unique part of the foreign target, called an antigen.
Thus (b) is correct option.

41. Antigens are present
(a) inside the nucleus.
(b) on cell surface
(c) inside the cytoplasm
(d) on the nuclear membrane.

Ans : FOREIGN 2007

Antigen is a toxin or other foreign substance which induces an immune response in the body, especially in the production of antibodies. Antigens include toxins, bacteria, foreign blood cells, and the cells of transplanted organs. Antigens are present on the cell surface.
Thus (b) is correct option.

42. A cell-coded protein that is formed in response to infection with most animal viruses is called
(a) interferon (b) antigen
(c) histone (d) antibody

Ans : COMP 2011

Interferon is a protein releases usually in response to the entry of a virus. It has the property of inhibiting virus replication. Interferon prevents the virus from reproducing within the infected cells and can also induce resistance to the virus in other cells.
Thus (a) is correct option.

43. The cytotoxic cells are produced by
(a) T-Cells (b) B-Cells
(c) memory Cells (d) mast Cells

Ans : DELHI 2005

Cytotoxic cells a subset of T lymphocytes that bind to other cells through MHCs and are involved in their destruction. Cytotoxic T lymphocytes kills cancer cells, cells that are infected (particularly with virus), or cells that are damaged in other ways.
Thus (a) is correct option.

44. The letter T in T-lymphocyte refers to
(a) thymus (b) thyroid
(c) thalamus (d) tonsil

Ans : OD 2013

The letter T in T lymphocytes refers to thymus.
Thus (a) is correct option.

45. The exaggerated response of the immune system to certain antigens is called
(a) primary response
(b) secondary response
(c) immune suppression response
(d) allergy

Ans : DELHI 2015

Allergy is the exaggerated response of the immune system to certain antigens present in the environment. The substances to which such as immune is produced are called allergens.
Thus (d) is correct option.

46. Passive immunity is defined as immunity
(a) inherited from the parents.
(b) achieved through vaccination.
(c) acquired through first exposure to the diseases.
(d) achieved through the sera of other animals enriched in antibodies.

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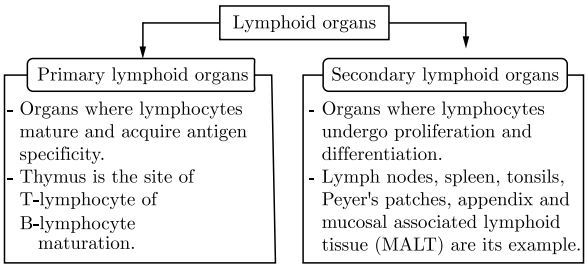
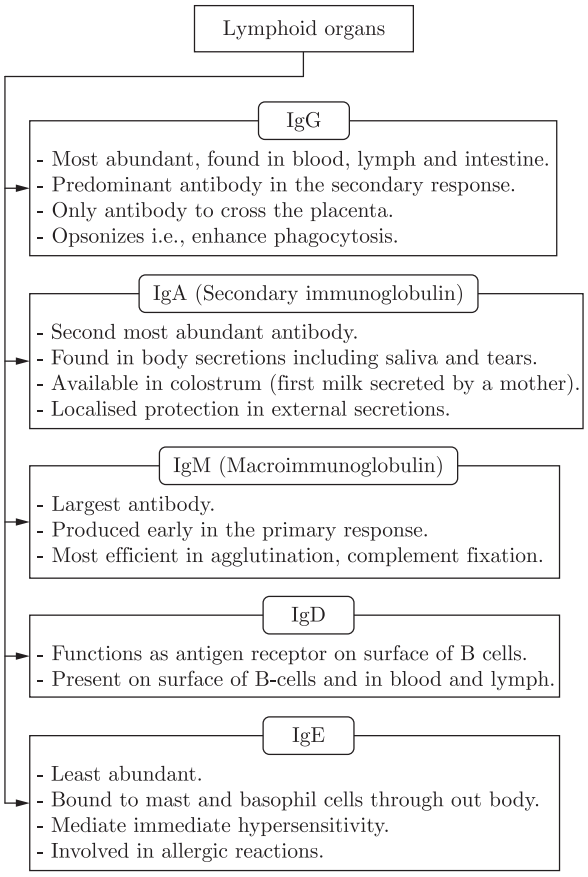
immune system comprises lymphoid organs, tissues and soluble molecules such as antibodies.

Flow Chart: Types of lymphoid organs





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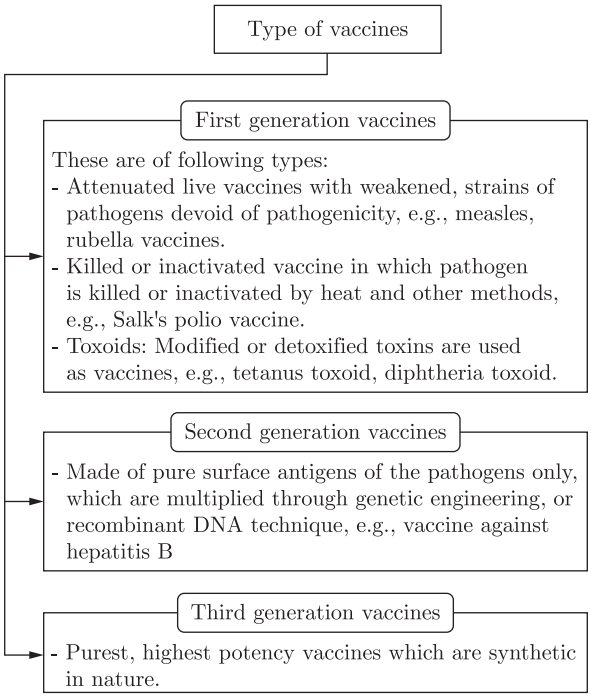
Vaccination and Immunisation

Vaccination (L. vacca-cow) is the process of development of immunity against a particular disease by inoculation of harmless antigenic material like attenuated pathogen or its toxoid into a healthy person.



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2. DISORDERS OF IMMUNE SYSTEM

Hypersensitivity (Allergy)

Hypersensitivity or allergy is the excessive immune response to common antigens called allergens.

Autoimmunity

Autoimmunity refers to abnormal immune responses in which the immune system fails to properly distinguish between self and non-self and attacks self body part. Examples of autoimmune disorders are rheumatoid arthritis, insulin dependent diabetes, chronic anaemia, chronic hepatitis, Grave's diseases etc.

AIDS

AIDS or acquired immune deficiency syndrome is a deficiency of immune system. It is accompanied by immune system. It is accompanied by a reduction in the number of helper T cells which stimulate antibody production by B-cells resulting in loss of natural defence against viral infection.

Cancer

Caner is a disease of uncontrolled proliferation of cells without any differentiation. It commonly originates in the tissue in which the cells are regularly replaced by mitosis.

22. Wuchereria bancrofit causes filaria in human being. It is of which group?
(a) Protozoa (b) Bacteria
(c) Virus (d) Helminth

Ans : OD 2009
Wuchereria bancrofit that cause filaria (elephantiasis) belongs to phylum helminthes.
Thus (d) is correct option.

23. Which organ of the body is most affected by excessive intake of alcohol?
(a) Lungs (b) Liver
(c) Stomach (d) Spleen

Ans : OD 2009
Liver is most badly affected by the excessive intake of alcohol. When our liver tries to break down alcohol, the resulting chemical reaction can damage its cells. This damage lead to inflammation and scarring as the liver tries to repair itself.
Thus (b) is correct option.

24. Which part of the donor's eye is used for grafting in order to cure certain cases of blindness?
(a) Lens (b) Retina
(c) Cornea (d) Choroid

Ans : OD 2009
The tissue that is most frequently donated and transplanted is the cornea. The cornea is a contact lens sized, clear piece of tissue in the front of the eye. It can be used to restore vision to corneal blind person.
Thus (c) is correct option.

25. The pathogens of genera, Microsporum, Trichophyton and Epidermorphyton are responsible for
(a) botulism (b) conjunctivitis
(c) ringworms (d) skin allergy

Ans : DELHI 2005
Pathogens for fungal disease called ring worm are Microsporum, Trichophyton and Epidermophyton. They are seen in groin, between toes, etc.
Thus (c) is correct option.

26. Identify the site where Wuchereria bancrofti is normally found on human body.
(a) Lymphatic vessels of the lower limbs
(b) Muscles of the legs
(c) Blood vessels of the thigh region
(d) Skin between the fingers

Ans : COMP 2010
Wuchereria (W. bancrofti and W.malayi), also called filarial worms chronic inflammation of the organs in which they live for many years, usually the lymphatic vessels of the lower limbs. The disease caused by them is known as elephantiasis or filariasis. The genital organs are mainly affected, resulting in gross deformities. The pathogens are transmitted to a healthy person through the bite by the female mosquito vectors.
Thus (a) is correct option.

27. Food poisoning is caused by
(a) Entamoeba histolytica
(b) Escherichia coli
(c) Clostridium botulinum
(d) Corynebacterium diptheriae

Ans : OD 2015
Food poisoning is an illness caused by bacteria or other toxins in food. Symptoms which generally begin within 2 to 6 hours include abdominal cramping, diarrhoea, fever, headache, nausea, vomiting, and weakness. Food poisoning is caused by Clostridium botulinum.
Thus (c) is correct option.

28. Amoebiasis is caused by
(a) Plasmodium vivax
(b) Entamoeba gingivalis
(c) Trypanosoma gambiense
(d) Entamoeba histolytica

Ans : DELHI 2020
Amobiasis (amoebic dysentery) is caused by intestinal endoparasitic protozoan, Entamoeba histolytica. Infection is transmitted by contamination.
Thus (d) is correct option.

29. Vector for kala azar is:
(a) sandfly (b) bedbug
(c) louse (d) housefly

Ans : COMP 2023
Kala azar is a chronic and potentially fatal parasitic diseases of the viscera (the internal organs, particularly the liver, spleen, bone marrow and lymph nodes) due to infection caused by Leishmania donovani. Leishmania donovani is transmitted by sand-fly bits. Kala-azar is associated with fever, loss of appetite (anorexia), fatigue, enlargement of the liver, spleen and nodes and suppression of the bone marrow.
Thus (a) is correct option.

30. Which of the following set includes bacterial diseases?
(a) Tetanus, typhoid, tuberculosis
(b) Small pox, influenza, tetanus

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10. The antibodies produced in allergy are of which type?
(a) IgA (b) IgE
(c) IgM (d) IgG

Ans : OD 2010
IgE antibodies are produced in case of allergy.
Thus (d) is correct option.

11. Oncology is the study of
(a) cancer (b) oncogenes
(c) both (a) and (b) (d) virus

Ans : OD 2015
Oncology is a branch of science that deals with the prevention, diagnosis and treatment of cancer.
Thus (a) is correct option.

12. Widal test is for
(a) AIDS (b) Malaria
(c) Tuberculosis (d) Typhoid

Ans : OD 2013
Wild test is performed for diagnosis of typhoid.
Thus (d) is correct option.

13. Elephantiasis is caused by:
(a) Ascaris (b) Taenia
(c) Wuchereria (d) entamoeba

Ans : OD 2012
Elephantiasis is caused due to worms Wuchereria brancrofti. It is transmitted through female culex mosquito.
Thus (c) is correct option.

14. Which among the following is not a bacterial disease?
(a) Thyphoid (b) Leprosy
(c) Diphtheria (d) Influenza

Ans : OD 2011
Influenza or flu is a viral infections disease, caused due to influenza virus. Its symptoms are high fever, runny nose, sore throat, head ache cough etc.
Thus (d) is correct option.

15. HIV attacks which of the following cells?
(a) β cell (b) T cell
(c) Epithelial cell (d) T helper cell

Ans : OD 2018
Human Immunodefeciency virus (HIV) specifically attacks helper T cells (CD-4 cells). This damages the immune system and gradually weakens our natural defences.
Thus (d) is correct option.

16. Which of the following is a sexually transmitted disease?
(a) Typhoid (b) Cholera
(c) malaria (d) Syphilis

Ans : OD 2010
Among the given options, syphilis is a sexually transmitted disease. It is caused by bacterium treponema pallidum.
Thus (d) is correct option.

17. Triple antigen vaccine is not used for:
(a) Diphtheria (b) Pertusis
(c) Typhoid (d) Tetanus

Ans : OD 2010
Triple antigen vaccine also called as DPT Vaccines work against three infections diseases in humans. These are diphtheria, pertussis and tetanus.
Thus (c) is correct option.

18. Which among the following is not a viral disease?
(a) Mumps (b) Influenza
(c) Diphtheria (d) Measles

Ans : OD 2010
Diptheria is a bacterial infection that affects the mucous memberanes of the throat and nose. It is caused by bacterium Corynebacterium diphtheriae.
Thus (c) is correct option.

19. The substances to which an immune response is produced are called:
(a) Allergens (b) Vaccines
(c) Antibodies (d) Antigens

Ans : OD 2010
Allergens are the substances against which immune response is produced. e.g.- dust, pollen grain etc.
Thus (a) is correct option.

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20. Chemicals released due to allergy are:
(a) Histamine (b) Serotonin
(c) Both (a) & (b) (d) None of these

Ans : OD 2010
Both histamines and serotonins are produced during allergic reactions. They are produced by mast cells.
Thus (c) is correct option.

21. Widal test is done to confirm:
(a) Malaria (b) Typhoid
(c) AIDS (d) Cancer

Ans : OD 2009
Widal test is performed to diagnose typhoid.
Thus (b) is correct option.

55. The foetus gets immunized after receiving antibodies from mother through placenta. This type of immunization is called.
(a) active immunity
(b) innate immunity
(c) passive immunity
(d) humoral immunity

Ans : SQP 2013

Transfer of antibodies present in the mother's milk to the infant is an example of passive immunity.
Thus (c) is correct option.

56. When a quick immune response is required due to infection of a deadly microbe, the patient is injected with
(a) protein of pathogen
(b) inactivated or weakened pathogen
(c) preformed antibodies
(d) vaccine

Ans : OD 2019

Preformed antibodies are derived from the blood serum of previously infected people or animals. They are often administered in an antiserum to another person in order to provide immediate, passive immunization against fast-acting toxins or microbes, such as those in snakebites or tetanus infections.
Thus (c) is correct option.

57. Which of the following vaccine has been produced from yeast by recombinant DNA technology?
(a) Hepatitis A (b) Hepatitis B
(c) Hib (d) Oral polio

Ans : DELHI 2005

Vaccine for human hepatitis B virus was prepared using antigen produced by recombinant technology in yeast (Saccharomyces cerevisiae). Yeast-derived vaccine was safe and was equally immunogenic and protective against hepatitis B as plasma-derived vaccine.
Thus (b) is correct option.

58. B-lymphocytes are associated with
(a) humoral immunity
(b) production of heparin
(c) cell mediated immunity
(d) internal cleansing

Ans : FOREIGN 2007

Immune response by the B-cells by production of antibody is called antibody mediated immune response or humoral immune response. Here, antibodies are found in blood plasma. So, it is called as humoral immune response.
Thus (a) is correct option.

59. Which of the following lymphoid organ provides the site for the interaction of lymphocytes with the antigen?
(a) Bone marrow (b) Thymus
(c) Spleen (d) All of these

Ans : COMP 2010

The spleen is the site of interaction of lymphocytes with the antigen. It is the organ that is responsible for purifying the blood as well as storing blood cells. It is the largest lymphatic organ in the body and serves a valuable role in immune function because it purifies the blood and helps the immune system with recognize and attack foreign antibodies an disease.
Thus (c) is correct option.

60. Which of the following is trapped in the lymph nodes and responsible for the activation of lymphocytes present there and cause the immune response?
(a) Antigen (b) Antibody
(c) Pathogen (d) Lymph fluid

Ans : OD 2010

Antigen trapped in the lymph nodes are responsible for the activation of lymphocytes present there and cause the immune response. Antigen is a toxin or other foreign substance which induces an immune response in the body, especially the production of antibodies.
Thus (a) is correct option.

61. Hepatitis B and AIDS are
(a) caused by Retro-viruses
(b) transmitted through sexual contact.
(c) congenital diseases.
(d) transmitted through infected blood.

Ans : DELHI 2016

Hepatitis B and AIDS are transmitted through infected blood. Hepatitis B, popularly called serum hepatitis or transfusion hepatitis is caused by hepatitis B virus. It is also called Dane parlicle. Transmission of hepatitis B includes blood (blood transfusion), tattoos etc. AIDS is caused by HIV which belongs to retrovirus. It is transmitted through body fluids by sexual contact, infected blood shared needles etc.
Thus (d) is correct option.

62. Human immuno deficiency virus (HIV) has a protein coat and a genetic material which is
(a) Single stranded DNA.

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(c) Meningitis, measles, syphilis
(d) None of the above.

Ans : **DELHI 2016**

Tetanus, typhoid, tuberculosis are bacterial diseases. Tetanus is caused by Clostridium tetani, typhoid is caused by Salmonella typhi and tuberculosis is caused by Mycobacterium tuberculosis.
Thus (a) is correct option.

31. Which of the following is a communicable disease?
(a) Malaria (b) Diabetes
(c) Hypertension (d) Kwashiorkar

Ans : **SQP 2012**

Communicable diseases spread from one person to another or from an animal to a person. The spread often happens via airborne viruses or bacteria, but also through blood or other bodily fluid. The terms infectious and contagious are also used to describe communicable disease. Communicable diseases includes malaria, typhoid etc.
Thus (a) is correct option.

32. Black water fever is a severe complicatin of
(a) Plasmodium falciparum
(b) P vivax
(c) P malariae
(d) all of the above

Ans : **FOREIGN 2015**

Black water fever disease is caused by Plasmodium falciparum which is also known as deadly tertian malaria.
Thus (a) is correct option.

33. Mumps is a viral disease and painful swelling of
(a) parotid glands
(b) thyroid
(c) thymus
(d) sublingual glands

Ans : **OD 2013**

Mumps is a viral disease caused by RNA containing paramyxo mumps virus. It involves painful swelling of parotid glands due to which patient has difficulty in swallowing and opening of mouth.
Thus (a) is correct option.

34. Which of the following disease is not transmitted through contaminated water?
(a) Typhoid (b) Diphtheria
(c) Amoebiasis (d) Hepatitis A

Ans : **SQP 2006**

Diphtheria is not transmitted through contaminated water. Diphtheria, caused by Corynebacterium diphtheria is spread through droplet infection and direct contact.
Thus (b) is correct option.

35. In which of the following diseases, there is always a time lag between the infection and appearance of the symptoms of that particular diseases?
(a) AIDS (b) Allergy
(c) Cancer (d) Alcoholism

Ans : **FOREIGN 2009**

AIDS is a disease in which there is a severe loss of the body's cellular immunity, greatly lowering the resistance to infection and malignancy. There is always a time lag between the infection and appearance of AIDS symptoms. This period may vary from a few months to many years (usually 5-10 years)
Thus (a) is correct option.

36. Infection of Ascaris usually occurs by
(a) eating imperfectly cooked pork.
(b) tse-tse fly.
(c) mosquito bite.
(d) drinking water containing eggs of Ascaris.

Ans : **COMP 2011**

Ascaris, an intestinal parasite causes ascariasis. Symptoms of these disease include internal bleeding, muscular pain, fever, anaemia and blockage of the intestinal passage. The eggs of the parasite are excreted along with the faeces of infected persons which contaminate soil, water, plants, etc. A healthy person acquires this infection through contaminated water vegetables, fruits, etc.
Thus (d) is correct option.

37. The cells affected in leukaemia are
(a) Plasma cells (b) erythrocytes
(c) thrombocytes (d) leucocytes

Ans : **OD 2019**

Leukemia is a group of cancers that usually begins in the bone marrow and results in high numbers of abnormal white blood cells. These white blood cells are not fully developed and are called blasts or leukemia cells. Symptoms may include bleeding and bruising problems, tiredness, fever and an increased risk of infections. These symptoms occur due to a lack of normal blood cells.
Thus (d) is correct option.

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OBJECTIVE QUESTIONS

1. Which of the following is an example of autoimmune disease?
(a) Asthma
(b) Rheumatoid arthritis
(c) Cancer
(d) None of these

Ans : OD 2024
Rheumatoid arthritis is an autoimmune disease. It affects joint linings, causing painful swelling. Over long periods of time, the inflammation associated with rheumatoid arthritis can cause bone erosion and joint deformity.
Thus (b) is correct option.

2. The toxic protein secreted by bacillus thuringiensis is:
(a) Tubulin (b) Insulin
(c) Cry protein (d) All of these

Ans : OD 2018
Bacillus thuringiensis posses cry gener that encodes for Bt toxin (cry protein) that have specific activities against insect species of order Lepidoptera, Diptera etc.
Thus (c) is correct option.

3. Oncogene is responsible for:
(a) Cancer (b) AIDS
(c) Tuberculosis (d) Pollo

Ans : OD 2017
An oncogene is a gene that has the potential to cause cancer. In tumor cells, they are often mutated and are expressed at high levels.
Thus (a) is correct option.

4. Which one is bacterial disease?
(a) Leprosy (b) Tuberculosis
(c) Cholera (d) All of these

Ans : OD 2017
All the given diseases are caused by bacteria. Leprosy is caused by mycobacterium leprae. Tuberculosis is caused due to mycobacterium tuber-culosis while cholera occurs due to vibrio cholerae.
Thus (d) is correct option.

5. Malaria is caused by:
(a) Male culex
(b) Female Anopheles
(c) Female Aedes
(d) Male Anopheles

Ans : OD 2017
Malaria is a protozoan disease caused by plasmodiun species. These are transmitted by female Anopheles mosquitoes.
Thus (d) is correct option.

6. Which of the following is a retro virus?
(a) Human Immuno Deficiency virus
(b) Hepatitis virus
(c) Micro virus influenzii
(d) All of these

Ans : OD 2018
The human immunodeficiency virus (HIV) is a lentivirus (a subgroup of retrovirus) that cause AIDS. It contains an enzyme, called reverse transcriptase, that gives them the unique property of transcribing their RNA into DNA after entering a cell. The retroviral DNA can then integrate into the chromosomal DNA of the host cell, to be expressed there.
Thus (a) is correct option.

7. HIV destroys which cell in AIDS disease?
(a) B-cell (b) C-cell
(c) T-lymphocyte (d) Both (a) and (b)

Ans : OD 2016
HIV is a virus that causes AIDS. This virus attacks specific type of immune system cells in the body, known as *CD*-4 helper lymprocytes (T_4 lymphocytes) cells, making our immune system weak.
Thus (c) is correct option.

8. Which one is viral disease?
(a) Flu (b) Polio
(c) AIDS (d) All of these

Ans : OD 2016
All the given disease are viral diseases. Flu is caused by influenza virus, polio is caused by polio virus while AIDS is caused by HIV virus.
Thus (d) is correct option.

9. T-lymphocytes originate from
(a) bone-marrow (b) stomach
(c) thymus (d) liver

Ans : OD 2015
T-lymphocytes originate in bone marrow and mature in the thymus. In the thymus, they get multiplied and differentiate into helper, cytotoxic and memory T-cells.
Thus (a) is correct option.

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Ans : SQP 2008

Passive immunity is a type of acquired immunity in which ready made antibodies are transferred from one individual to another. It is acquired through first exposure to the disease.
Thus (c) is correct option.

47. When body cannot differentiate between its own and foreign matter it is referred to as
(a) passive immunity
(b) active Immunity
(c) autoimmunity
(d) immunodeficiency

Ans : FOREIGN 2012

Autoimmunity is the memory based acquired immunity, which is not able to distinguish foreign molecules or cells (pathogen) from self-cells.
Thus (c) is correct option.

48. Short-lived immunity acquired from mother to foetus across placenta or through mother's milk to the infant is categorized as
(a) active immunity
(b) passive immunity
(c) cellular immunity
(d) innate non-specific immunity

Ans : COMP 2017

Passive immunity is the short-term immunity which results from the introduction of antibodies from another person or animal, from the transfer of antibodies through the placenta or from colostrum.
Thus (b) is correct option.

49. Organ transplant rejection may be prevented by using
(a) antibodies
(b) new T cells
(c) immunosuppressive drug
(d) immunostimulatory drug

Ans : OD 2011

Immunosuppressive drug are those drugs that inhibit or prevent activity of the immune system. They are used in immunosuppressive therapy to prevent the rejection of transplanted organs and tissues (e.g., bone marrow, heart, kidney and liver etc.).
Thus (c) is correct option.

50. Antigen binding site is an antibody is found between
(a) two light chains
(b) two heavy chains
(c) one heavy and one light chain
(d) either between two light chains or between one heavy and one light chain depending upon the nature of antigen.

Ans : DELHI 2005

Antigen binding site is a region on an antibody that binds to antigens. It is composed of one constant and one variable domain of each of the heavy and the light chain. Antigen binding site in an antibody is found in between one heavy and one light chain.
Thus (c) is correct option.

51. Inflammatory response in allergy is caused by
(a) histamines (b) antigen
(c) prothrombin (d) antibodes

Ans : DELHI 2015

Allergy is due to the release of chemicals like histamine and serotonin from the mast cells.
Thus (a) is correct option.

52. Resistance in body against diseases is give by
(a) vaccinations (b) histamine
(c) immunoglobulins (d) antigens

Ans : FOREIGN 2022

Resistance in body against diseases is given by antibodies or immunoglobulins.
Thus (c) is correct option.

53. The principle of vaccination is based upon which property of immune system?
(a) Memory (b) Diversity
(c) Specificity (d) All of these

Ans : COMP 2020

The principle of vaccination is based upon the memory of immune system. When a pathogen for the first time infects a person; it produces primary immune response which is of low intensity. When the same pathogen attacks again, highly intensified secondary (anamnestic) response is generated, thereby preventing the occurrence of disease.
Thus (a) is correct option.

54. Which of the following results in fever when released in body during disease?
(a) Pyrogens (b) Antibodies
(c) Interferons (d) Interleukins

Ans : DELHI 2018

Pyrogens is released in body during disease.
Thus (a) is correct option.

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Mumps	Paramyxovi-rus	Droplet infection	Inflammation of period glands	MMR vaccine
Measles	Rubeola virus	Droplet infection	Reddish rash appears on neck which spreads over body	MMR vaccine
Protozoan diseases				
Amoebiasis	Entamoeba histolytica	Faecal oral route	Abdominal pain, passing out of mucus and blood in faeces.	Metronidazole and tinidazole.
African sleeping sickness	Trypanosoma gambiense	By the bite of Glossina palpalis	The pathogen inhabits cerebrospinal fluid and migrates to brain. The patient becomes lethargic and unconcious.	
Kala-azar	Leishmania donovani	By the bite of phlebotomus argentipes	Swelling, high fever and enlargement of spleen and liver, followed by general weakness and anaemia..	
Helminthic diseases				
Ascariasis	Ascaris lumbricoides	A healthy person acquires infection thorugh contaminat-ed water, soil, etc.	Adult worms obstruct the intestinal passage thereby causing abdominal discomforts like colic pains, indigestion, diarrhoea and vomiting.	Mebendazole, alcopar, Zental
Filariasis/ Elephantia-sis	Wuchereria bancrofti	Bite of Culex mosquito	Permanent swelling mostly of feet, legs, thighs, scrotal sacs, breast, etc.	Albendazole, Dieth- ylcarbamaz-ine
Fungal disease				
Ringworm/ Tinea	Trichophyton, Epidermop-phyton, Microsporum	From soil or by using towels, clothes or comb of infected persons	Appearance of dry, scaly lesions on various parts of the body such as skin, nails and scalp, accompanied by intense itching.	Griseofulvin and Miconazole

NODIA

Malaria

Malaria is caused by a digenetic (having two hosts to complete its life cycle) and triphasic (having three phases of life cycle) protozoan parasite known as Plasmodium.

Life cycle of Plasmodium requires two hosts for completion human and mosquito. Plasmodium enters the human body as sporozoites (infection form) through the bite of infected female Anopheles (vector). The sporozoites reach the liver cells via blood where they initially multiply.

Non-Communicable diseases

Diabetes, Cardiovascular and orthridis are non-communicable diseases. Diabetes a endocriue disorder of tue paricreas when either insulin is produced iusufficiently or become now functional. Arthridis is a geural term that is applied to different malpunctions of the joints.

Immunity

The overall ability of an organism to fight with the disease-causing organisms, conferred by the immune system is called immunity. The human

(b) Single stranded RNA.
(c) Double stranded RNA.
(d) Double stranded DAN.

Ans : **SQP 2022**

The human immunodeficiency virus is a lentivirus that causes the acquired immunodeficiency syndrome, a condition in humans in which progressive failure of the immune system allows life threatening opportunistic infections and cancers to thrive. HIV has a protein coat and a genetic material which is single stranded RNA.
Thus (b) is correct option.

63. Which is not immunity related disease?
(a) AIDS (b) Polio
(c) Cancer (d) Small Pox

Ans : **COMP 2023**

Cancer is not an immunity related disease. Cancer is a disease caused by an uncontrolled division of abnormal cells in the body. It may spread through the lymphatic system or blood stream to other parts of the body. It is a progressive disease, and goes through several stages. Each stage may produce a number of symptoms. Some symptoms are produced early and may occur due to a tumor that is growing within an organ or a gland. As the tumor grows, it may press on the nearby nerves, organs, and blood vessels. This causes pain and some pressure which may be the earliest warning signs of cancer.
Thus (c) is correct option.

64. Which of the following endocrine glands is often referred in relation with AIDS?
(a) Thyroid (b) adrenal
(c) Thymus (d) Pancreas

Ans : **DELHI 2005**

Thymus gland is related with AIDS (the final stage of HIV infection), because HIV decreases natural immunity of the body by attacking T-lymphocytes. T lymphocyte is a type of lymphocyte which is produced is a type of lymphocyte which is produced or processed by the thymus gland and actively participating in the immune response.
Thus (c) is correct option.

65. Which is of the following non-infectious disease is a major cause of death in human beings?
(a) AIDS (b) Cirrhosis
(c) Cancer (d) Asthma

Ans : **FOREIGN 2012**

Cancer is an abnormal, uncontrolled and unwanted growth of cells. e.g. Breast cancer, leukemia, Cancer is not a contagious disease. It is the major cause of death in human beings.
Thus (c) is correct option.

66. Cancer cells are more easily damaged by radiation than normal cells because they are
(a) non-dividing
(b) starved of mutation
(c) different in structure
(d) undergoing rapid division

Ans : **OD 2017**

Cancer cells are more easily damaged by radiation than normal cells because they are undergoing rapid division. Radiation is energy that's carried by waves or a stream of particles. Radiation works by damaging the genes (DNA) in cells which control how cells grow and divide. When radiation damages the genes of cancer cells, they can't grow and divide any more. Over time, the cells die. This means radiation can be used to kill cancer cells and shrink tumors. Radiation therapy is always a balance between destroying the cancer cells and minimizing damage to the normal cells.
Thus (d) is correct option.

67. Metastasis is
(a) part of regeneration
(b) transfer of cancer cells from one part of the body to another
(c) fast mitosis in cancer cells
(d) all of the above

Ans : **DELHI 2007**

Metastasis is the pathological process of spreading cancerous cells to the different part of the body. It is exhibited by malignant tumors. These cells divide uncontrollably, forming a mass of cells called tumor.
Thus (d) is correct option.

68. Techniques like radiography (use X-rays), CT scanning and MRI are very useful to detect
(a) autoimmune disorders.
(b) disease caused by viral infection
(c) disease caused by bacterial infection.
(d) disease caused by an uncontrolled division of abnormal cells of internal organs.

Ans : **OD 2013**

Cancer is a disease caused by an uncontrolled division of abnormal cells in the body. Techniques like radiography (use of X-rays), CT scanning and MRI are very useful to detect cancers of internal organs. Computed tomography uses

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(c) The Assertion is correct but Reason is incorrect.

(d) Both the Assertion and Reason are incorrect.

Ans : **DELHI 2012**

Interferons are natural proteins produced by the cells of the immune system in response to challenges by foreign agents such as viruses, parasites and tumor cells. Interferons belong to the large class of glycoproteins known as cytokines. Interferons are produced by a wide variety of cells in response to the presence of double-stranded RNA, a key indicator of viral infection. Interferons assist the immune response by inhibiting viral replication within host cells, activating natural killer cells and macrophages, increasing antigen presentation to lymphocytes, and inducing the resistance of host cells to viral infection. When the antigen is presented to matching T and B cells, those cells multiply and strategically and specifically wipe out the foreign substance. That is why antigen presentation is so important to the immune response.

Thus (d) is correct option.

95. **Assertion :** Mast cells in the human body release excessive amounts of inflammatory chemicals, which cause allergic reactions.

Reason : Allergens in the environment on reaching human body stimulate mast cells in certain individuals.

(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) The Assertion is correct but Reason is incorrect.

(d) Both the Assertion and Reason are incorrect.

Ans : **FOREIGN 2016**

A mast cell contains many granules rich in histamine serotonin and heparin. Although best known for their role in allergy and anaphylaxis, mast cells play an important protective role as well, being intimately involved in wound healing and defense against pathogens. The symptoms of an allergic reaction develop in response to histamine. Mast cells release a large amount of histamine into the blood stream and it also act as initiator of the inflammatory response, which aids the arrival of leucocytes at a site of infection. Histamine stimulates capillary dilation increased capillary permeability, closure of bronchial tubes, mucus secretion, pain and swelling.

Thus (a) is correct option.

96. **Assertion :** Cannabis sativa is a powerful anti-depressant.

Reason : Hashish and Marijuana are derived from it.

(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) The Assertion is correct but Reason is incorrect.

(d) Both the Assertion and Reason are incorrect.

Ans : **SQP 2019**

Cannabis sativa or Hemp is an annual herb of cannabaceae family. It is mainly the source of fibre. Cannabis sativa is not an antidepressant. Antidepressant is a psychiatric medication used to alleviate mood disorders such as major depression. Hashish and Marijuana are drugs derived from it. Preparations of flowers of Cannobis is called marijuana while preparations of the resinous extract is called hashish. Both are consumed by smoking, vapourising and oral ingestion and are hallucinogen drugs that cause acute panic anxiety reaction.

Thus (d) is correct option.

97. **Assertion :** HIV infected person are prone to oppurtunistic diseases.

Reason : Immune system weakens during HIV infection.

(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) The Assertion is correct but Reason is incorrect.

(d) Both the Assertion and Reason are incorrect.

Ans : **OD 2012**

Usually, person shows symptoms of HIV infection within 2 to 6 weeks of exposure to the virus. But in some persons, the virus may remain silent for long periods (upto 10 years) before symptoms of full blown AIDS are observable. The symptoms of HIV infection include fever, lethargy, pharyngitis, nausea, headache, rashes etc. Persons suffering from AIDS have a weakened immune system due to depletion of T-helper cells. Such persons show opportunistic infections, i.e., infection by those fungi, bacteria and viruses to which a person with normal immune system is expected to be resistant. Therefore, persons prone to opportunistic infections may be suspected to be

NODIA

plant, Atropa belladonna, containing atropine and related alkaloids.
Thus (d) is correct option.

78. Narcotic drugs like charas, bhang and ganja are extracted from
(a) hemp plant (b) coco plant
(c) poppy seeds (d) hallucinogen

Ans : COMP 2011

Natural cannabinoids are obtained from Cannabis sativa (Hemp plant). Its flower tops, leaves and resin are used to produce bhang, ganja, charas (hashis), marijuana etc.
Thus (a) is correct option.

79. Hashish and charas are obtained from
(a) Rauwolfia serpentina
(b) Cannabis sativus
(c) Papaver somniferum
(d) Claviceps purpurea

Ans : OD 2015

Hashish and charas are obtained form Cannabis satia. Cannabis sativa (bhang) is an annual herbaceous plant in the Cannabis genus, a species of the cannabaceae family.
Thus (b) is correct option.

80. Opium is obtained from which part of the plant papaver somniferum?
(a) Inflorescence (b) Male part (dried)
(c) Seed (unripe) (d) Leave

Ans : OD 2018

Opium is a highly addictive narcotic drug acquired in the dried latex form from the seed pod of opium poppy (papaver somniferum). Traditionally the unripened pod is slit open and the sap seeps out and dries on the outer surface of the pod. The resulting yellow-brown latex, which is scraped off of the pod, is bitter in taste and contains varying amounts of alkaloids such as morphine, codeine, the baine and papaverine.
Thus (c) is correct option.

81. Ergot, a drug is derived from fungus
(a) Aspergillus (b) Phytopthora
(c) Clavicep (d) perenospora

Ans : DELHI 2019

Ergot is a disease of rye and other cereal grasses, caused by a fungus of the genus Claviceps, especially C. purpurea, which replaces the affected grain with along, hard, blackish sclerotial body. Therefore its drug is derived from the Claviceps.
Thus (c) is correct option.

82. Cirrhosis of the liver is caused by
(a) cocaine (b) LSD
(c) alcohol (d) morphine

Ans : FOREIGN 2012

Cirrhosis is a complication of liver diseases which is characterized by abnormal structure and function of the liver. Cirrhosis of liver is caused by alcohol. There are many cause of cirrhosis including chemicals (such as alcohol, fat, and certain medications), viruses, toxic metals (such as iron and copper that accumulate in the liver as a result of genetic diseases), and autoimmune liver diseases in which the body's immune system attacks the liver.
Thus (c) is correct option.

83. LSD is obtained from
(a) bryophyte (b) pleridophyte
(c) brown algae (d) fungus

Ans : DELHI 2016

LSD is obtained from Ergot fungus (Claviceps purpurea). It is one of the most dangerous hallucenogens of modern times.
Thus (d) is correct option.

ASSERTION AND REASON

DIRECTION : Each of these questions contains as Assertion following by Reason. Read them carefully and answer the question on the basis of following options. You have to select the one that best describes the two statements.

84. **Assertion :** There is no chance of malaria to a man on the bite of male Anopheles mosquito.
Reason : It carries a non-virulant strain of Plasmodium.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : COMP 2005

Male Anopheles mosquito do not have piercing and sucking type of mouth parts. So, they can not inject malarial parasite into man.
Thus (c) is correct option.

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X-rays to generate a three dimensional image of the internal objects. MRI uses strong magnetic fields and non-ionizing radiations to accurately detect pathological and physiological changes in the living tissue.
Thus (d) is correct option.

69. TB is cured by
(a) griseofulvin (b) ubiquinone
(c) rifampin (d) eucitol

Ans : SQP 2008

Rifampin is antibacterial prescribed in the treatment of tuberculosis.
Thus (c) is correct option.

70. The use of antihistamine, adrenaline and steroids quickly reduce the symptoms of
(a) fungal disease
(b) viral disease
(c) allergy
(d) helminthes disease

Ans : FOREIGN 2019

Drugs like anti-histamine, adrenaline and steroids quickly reduce the symptoms of allergy.
Thus (c) is correct option.

71. LSD is obtained from
(a) Cannabis sativus
(b) Erythroxylon cocca
(c) Claviceps purpurea
(d) Papaver somniferum

Ans : FOREIGN 2015

Lysergic acid diethylamide (LSD), discovered in 1938, is ahallucinogen. It is manufactured from lysergic acid, which is found in ergot, a fungus (Claviceps purpurea)that grows on rye and other grains. It is odourless, colorless, and has a slightly bitter taste.
Thus (c) is correct option.

72. The drug "Belladonna" is obtained from
(a) Rauwolfia (b) Atropa
(c) Capsicum (d) Solanum

Ans : COMP 2017

Belladonna is a drug prepared from the dried leaves and root of deadly nightshade poisonous plant, Atropa belladonna, containing atropine and related alkaloids. It is used in medicine to check secretions and spasms, to relieve pain or dizziness and as a cardiac and respiratory stimulant.
Thus (b) is correct option.

73. Which of the following are hallucinogens?
(a) Charas (b) Bhang
(c) Ganja (d) All of these

Ans : DELHI 2007

Bhang, ganja, charas (hashish), marijuana etc. are hallucinogens.
Thus (d) is correct option.

74. Which of the following is a narcotic drug?
(a) Heroin (b) Codeine
(c) Morphine (d) All of these

Ans : SQP 2019

Narcotic drug are psychoative compound with sleepinducing properties. They include mainly plant-based products such as opium and its derivatives morphine, codeine and heroin, but also synthetic narcotics such as methadone and pethidine, as well as cannabis, coca and cocaine.
Thus (d) is correct option.

75. Cyclosporin is used as is
(a) allergic eczema
(b) immunosuppressant
(c) prophylactic for viruses
(d) prophylactic for marasmus

Ans : COMP 2005

Cyclosporin is used as immunosuppresant. It (Cyclosporin A) is a biologically active metabolite obtained from Tolypocladium infatum and certain other fungi. It has shown to prolong graft survival in kidney, liver, heart and lung transplants.
Thus (b) is correct option.

76. Opium is obtained from
(a) Papaver somniferum
(b) Rauwolfia serpentina
(c) Cannabis sativus
(d) Claviceps purpurea

Ans : COMP 2012

Opium is obtained from dried latex of unripe capsules of Poppy plant (Papaver somniferum).
Thus (a) is correct option.

77. From which part of Atropa belladonna is the drug 'belladonna' obtained?
(a) Stems
(b) Flowers
(c) Leaves
(d) Dried leaves and roots

Ans : SQP 2006

Belladonna is a drug prepared from the dried leaves and root of deadly nightshade poisonous

NODIA

(c) The Assertion is correct but Reason is incorrect.

(d) Both the Assertion and Reason are incorrect.

Ans : **FOREIGN 2011**

Anti tetanus is a disinfectant i.e. it prevents the infection due to the entry of bacteria through wounds. Thus (c) is correct option.

91. Assertion : Antigen can be easily recognized because it has antigenic determinants.

Reason : The recognition ability is innate.

(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) The Assertion is correct but Reason is incorrect.

(d) Both the Assertion and Reason are incorrect.

Ans : **COMP 2019**

Antigen is a substance that when introduced in the body, stimulate the production of antibody. They are mostly proteins but may be carbohydrates, lipids, nucleic acids etc. One antigen can bind with many antibodies. Every antigen has many antigenic determinants called epitopes.

The recognition ability of antibody is innate and develops without exposure to the antigen.

Thus (b) is correct option.

92. Assertion : Escherichia coli, Shigella sp. and Salmonella sp. are all responsible for diarrhoeal diseases.

Reason : Dehydration if common to all types of diarrhoeal diseases and adequate supply of fluids and electrolytes should be ensured.

(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) The Assertion is correct but Reason is incorrect.

(d) Both the Assertion and Reason are incorrect.

Ans : **COMP 2005**

Diarrhoeal disease conditions include frequent and excessive discharge of watery material from the bowel. Such diseases mostly result from ingestion of harmful germs with food and water. *E*. coli, Shigella sp. and salmonella sp. causes diarrhoea. Diarrhoea caused by virus, bacteria or parasites two characteristics-firstly, the offending organisms colonise the intestine and as a consequence cause inflammation of the intestine or enteritis; and secondly, they upset the balance of intestinal fluid absorption and secretion mechanism, often enhancing the latter very considerably, which is then manifested as watery stool discharged frequently in large volumes. Shigella sp, Salmonella sp. are quite closely related genera that are responsible for diarrhoeal diseases. Dehydration is common to all types of diarrhoeal diseases and adequate supply of fluids and electrolytes that provides ions, should be ensured.

Thus (b) is correct option.

93. Assertion : Dope test is used to estimate the level of blood alcohol by analyzing the breath of persons drinking alcohol.

Reason : A drunken person usually feels tense and less talkative.

(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) The Assertion is correct but Reason is incorrect.

(d) Both the Assertion and Reason are incorrect.

Ans : **OD 2015**

Blood alcohol test measures the amount of alcohol (ethanol) in the body. Alcohol is quickly absorbed into the blood and can be measured within minutes of having an alcoholic drink. The amount of alcohol in the blood reaches its highest level about an hour after drinking. But food in the stomach may increase the amount of time it takes for the blood alcohol to reach its highest level. About 90% of alcohol is broken down in the liver. The rest of it is passed out of the body in urine and your exhaled breath. Symptoms of alcohol intoxication include confusion, lack of coordination, unsteadiness that makes it hard to stand or walk, or erratic or unsafe driving. Dope test is a blood test to know whether a person used any drug to improve their performance. Thus (d) is correct option.

94. Assertion : Interferons are a type of antibodies produced by body cells infected by bacteria.

Reason : Interferons stimulate inflammation at the site of injury.

(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

NODIA

129. Virus infected cells provide innate immunity to other cells. Explain how?

Ans : SQP 2010

Virus infected cells release interferons, which prevent other uninfected cells from further viral infection. Thus, providing innate immunity.

130. In what way is monocyte a cellular barrier with reference to immunity?

Ans : DELHI 2012

Monocytes are the cellular barriers. Monocytes become macrophages, present both in fixed and wandering states. They phagocytose and eliminate microbes and foreign particles whenever they enters the body.

131. What are psychedelic drug?

Ans : SQP 2005

Psychedelic drugs are hallucinogens. They effect cerebrum and sense organs.

132. How does saliva act in body defence?

Ans : FOREIGN 2011

Saliva in mouth prevents the growth of microbes.

133. When does the human beings elicit an anamnestic response?

Ans : DELHI 2017

When a human body encounters a pathogen for second time, it elicits an anamnestic response.

134. What type of antibodies present in colostrum protect the newborn from certain diseases?

Ans : COMP 2023

IgA.

135. Write the name of plant from which morphine is obtained.

Ans : OD 2009

Papaver somniferum (poppy).

136. Vaccination provides a category of adaptive immunity. Name it.

Ans : DELHI 2006

Active immunity.

137. Which gland is large sized at birth but reduces in size with age?

Ans : SQP 2005

Thymus gland.

138. Give the name of plant from which we get cocaine.

Ans : FOREIGN 2010

Erythroxylum coca.

139. Name the drugs obtained from hemp plant.

Ans : COMP 2012

Bhang, ganja and charas.

140. What is the source of drug LSD?

Ans : OD 2018

The fungus, Claviceps purpurea is the source of LSD.

141. Why are sports persons tested strictly before an event?

Ans : DELHI 2023

To detect the presence of any performance enhancing drug.

142. When does a tumour called malignant?

Ans : SQP 2005

When the tumour cells proliferates and spreads to other parts of the body, it is called as malignant.

SHORT ANSWER QUESTIONS

143. Draw a neat,well labelled diagram of a typical antibody.

Ans : SQP 2012

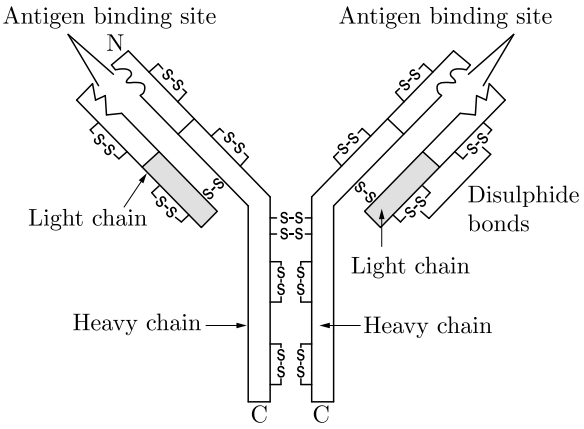

Fig Structure of an antibody molecule

144. Define Endoparasitic protozoans.

Ans : OD 2017

These are the parasitic protozoans that live inside the body of another type of organism (a host) and gets nutrition directly from the body of the host. These can be intercellular or intracellular parasite. Example, monocystis live as endoparasite in coelomic epithelial cells and seminal vesicles of earth worm. Another is plasmodium species causing malaria in human beings.

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infected by HIV, particularly, if the count of T helper cells in 200/ml or lower.
Thus (a) is correct option.

98. Assertion : Histamine is involved in allergic and inflammatory reactions.
Reason : Histamine is a vasodilator.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **COMP 2005**

Histamine is a derivative of the amino acid histidine produced by damaged cells of vertebrates. When released, it has the effect of dilating capillaries and lowering blood pressure. Histamine is involved in allergic and inflammatory reactions also.
Thus (a) is correct option.

99. Assertion : The antibodies separted from serum are homogenous.
Reason : Monoclonal antibodies are homogenous immunological reagents.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **DELHI 2018**

From hyperimmunized animals, the blood serum may be taken and antibodies may be isolated from this serum. However, the antibodies, whenever separated from serum after induction due to an antigen, are usually heterogenous, because the cells keep on producing a variety of antibodies. Monoclonal antibodies (Mabs), on the other hand are homogeneous immunological reagents of defined specificity so that these can be utilized for diagnosis and screening of disease.
Thus (d) is correct option.

100. Assertion : Epstein-Barr virus is an oncovirus.
Reason : It stimulates the growth of cancer.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **COMP 2016**

Oncoviruses are cancer- causing viruses and may be DNA or RNA virus e.g., Epstein -Barr-Virus, Herpes simplex type 2 virus etc. This shows that the development of cancerous tumour is associated with certain genes.
Thus (a) is correct option.

NODIA

101. Assertion : Interferons are effective against viruses.
Reason : Proteins which can be synthesized only by genetic engineering are effective against viruses.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **SQP 2022**

Interferons are proteins that are effective against most viruses. They are naturally produced by virus infected cells. The proteins interact with adjacent cells and make them resistant to virus attack. Now interferons are also being manufactured through genetic engineering.

Interferons control the multiplication of virus particles by inhibiting their protein synthesis.
Thus (c) is correct option.

102. Assertion : Cancer calls are virtually immortal until the body in which they reside dies.
Reason : Cancer is caused by damage to genes regulating the cell division cycle.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **2021**

Cancer cells divide and redivide mitotically and is due to the activation of pro-oncogenes.
Thus (b) is correct option.

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103. **Assertion :** Cocaine has potent stimulating action on central nervous system, producing a sense of euphoria and increased energy.
Reason : Injecting the microbes intentionally during immunisation or infectious organisms gaining access into body during natural infection induces active immunity.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **COMP 2005**

Cocaine is obtained from the cocaplant, erthyroxylum coca. Cocaine is commonly called as coke or crack which is usually snored. It has a potent stimulating action of euphoria and increased energy. It interferes with the transport of the neurotransmitter dopamine. Its increased dosages cause hallucinations.
Thus (c) is correct option.

104. **Assertion :** Artificially acquired passive immunity results when antibodies or lymphocytes produced outside the host are introduced into a host.
Reason : A bone marrow transplant given to a patient with genetic immunodeficiency is an example of artificially acquired passive immunity.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **COMP 2012**

Artificially acquired passive immunity results when antibodies or lymphocytes that have been produced outside the host are introduced into a host. This type of immunity is immediate short lived, lasting only a few weeks to a few months. An example is bone marrow transplant given to a patient with genetic immunodeficiency.
Thus (b) is correct option.

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VERY SHORT ANSWER QUESTIONS

105. Highlight the role of thymus as a lymphoid organ.

Ans : **FOREIGN 2008**

Thymus is a primary lymphoid organ, where immature lymphocytes differentiate into antigen-sensitive T-lymphocytes.

106. Name the cells that are released from the above mentioned gland. Mention how they help in immunity.

Ans : **COMP 2010**

T-lymphocytes are released.
(i) They help B-cell to secrete antibodies.
(ii) They are involved in cell-mediated immunity (in organ transplantation).

107. Name the lymphoid organ in human, where all the blood cells are produced.

Ans : **OD 2013**

Bone marrow.

108. Name the causative agent of typhoid in humans.

Ans : **DELHI 2016**

Salmonella typhi.

109. Name the test administered to confirm the disease

Ans : **FOREIGN 2018**

Widal test,

110. Name the stage of Plasmodium that gains entry into the human body.

Ans : **SQP 2022**

Sporozoite.

111. What is vaccination? Answer in two lines.

Ans : **OD 2012**

Vaccination is the administration of antigenic material (a vaccine) to stimulate an individual's immune system to develop adaptive immunity to pathogen. Vaccines can prevent or ameliorate infectious disease.

112. Write two symptoms of cancer.

Ans : **OD 2011**

Cancer is a group of diseases involving abnormal cell growth with the potential to invade or spread to other parts of the body. Symptoms vary widely or they may not occur at all. Some patients have abnormal bumps, unexplained fevers, night sweats or unintentional weight loss.

113. Explain the cause of periodic recurrence of chill and high fever during malarial attack in humans.

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Ans : COMP 2005

The rupture of RBCs is associated with the release of a chemical called haemozoin, which is responsible for the chill and high fever.

114. Write the scientific names of the two species of filarial worms causing filariasis.

Ans : COMP 2016

Filariasis is caused by Wuchereria bancrofti and W.malayi.

115. How does the disease spread?

Ans : OD 2022

The disease is transmitted by the bite of female mosquito vectors.

116. What is the functional difference between B-cells and T-cells.

Ans : DELHI 2021

The difference between B-Cells and T-Cells are as follows :

B-Cells	T-Cells
They produce the antibodies, that form the part of humoral immunity.	They stimulate B-cells to produce antibodies and they constitute the cells-mediated immunity and are responsible for rejecting organ transplants.

117. Name the source used to produce hepatitis B vaccine using rDNA technology.

Ans : SQP 2018

Yeast cells.

118. Name the type of antibody.

(i) Present in colostrum

(ii) Produced in response to allergies in human body.

Ans : FOREIGN 2013

(i) IgA

(ii) IgE

119. Name a drug used:

(i) As an effective sedative and painkiller.

(ii) For helping patients to cope with mental illnesses like depression, but often misused.

Ans : COMP 2015

(i) Morphine.

(ii) Lysergic acid diethylamides (LSD) or barbiturates.

120. How does the moderate and high dosage of cocaine affect the human body?

Ans : OD 2019

Moderate does of cocaine have a stimulating action on the central nervous system and produce a sense of euphoria and increased energy.
High dosage of cocaine causes hallucination.

121. Give the most accurate definition of health.

Ans : SQP 2005

It is the state of complete physical, mental and social well being of a person.

122. Which chemical test is used for diagnosis of typhoid?

Ans : DELHI 2015

Widal test

123. How is chikungunya transmitted?

Ans : SQP 2013

Chikungunya is transmitted by the bite of Aedes aegypti mosquito.

124. Name the toxin responsible for the appearance of symptoms of malaria in human. Why do these symptoms occurs periodically?

Ans : FOREIGN 2014

The toxin responsible for symptoms of malaria is haemozoin. It is released when RBCs get ruptured due to erythrocytic schizogony of Plasmodium that takes place every 48 hrs.

125. Where does the sexual reproduction of malarial parasite take place?

Ans : FOREIGN 2019

It takes place inside the intestine of an Anopheles mosquito.

126. How does the pathogen of ringworm spread?

Ans : COMP 2009

The pathogen of ringworm spreads by using towels, clothes and even comb of an infected person

127. Malaria, typhoid, pneumonia and amoebiasis are some of the human infectious diseases. Which of these are transmitted through mechanical carriers?

Ans : OD 2006

Amoebiasis and typhoid.

128. Why do pollen grains of some flower trigger sneezing in some people?

Ans : FOREIGN 2012

Pollen grains of some flower cause allergies, because they induce the release of histamine and serotonin. These chemicals trigger sneezing in some people.

NODIA

85. Assertion : Rabies is an infection of mammals, it involves central nervous system which may result in paralysis and finally death.
Reason : This is caused by neurotropic bacteria in saliva of rabies animal.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **COMP 2018**
Rabies (hydrophobia) is caused by rabies virus. Its vectors are raboid animals especially dogs. It leads to encephalitis, fear of water (hydrophobia), high fever, severe headache, spasm of throat and chast, leading to death. Thus (c)is correct option.

86. Assertion : Plasmodium vivax is responsible for malaria.
Reason : Malaria is caused by polluted water.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **SQP 2012**
Malaria is caused by Plasmodium whose sexual phase occurs in the mosquito Anopheles. When female Anopheles feed on blood, then can serve as vector host for malarial parasite.
Thus (b) is correct option.

87. Assertion : Histamine is related with allergic and inflammatory reactions.
Reason : Histamine is a vasodilator.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **FOREIGN 2019**
Histamine is produced by mast cells in response to the allergy and inflammatory reaction. When histamine is released from mast cells, it causes vasodilation and an increase in permeability of the blood vessel walls. These effects, in turn cause the common symptoms of allergy including a running nose and watering eyes. Thus (a) is correct option.

88. Assertion : Organ transplantation patients are given immunosuppressive drugs.
Reason : Transplanted tissue has antigens which stimulate the specific immune response of the recipient.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **OD 2016**
Success of organ transplant depends on proper matching of histocompatibility of antigens that occurs in all cells of the body. As there are antigens which are likely to be attacked by recipient's T-cells and antibodies, the recipient of organ transplant is always given immunosuppressants to prevent immune rejection of the transplanted tissue.
Thus (a) is correct option.

89. Assertion : LSD and marijuana are clinically used as a analgesics.
Reason : Both these drugs suppress brain function.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **SQP 2016**
LSD and marijuana are anti inflammatory, sedative, anticonvulsive and laxative in action.
Thus (c) is correct option.

90. Assertion : A person who has received a cut and is bleeding needs to be given anti-tetanus treatment.
Reason : Anti-tetanus injection provides immunity by producing antibodies for tetanus.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

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145. How is rabies caused? Write its symptoms and control measures.

Ans : **OD 2016**

Rabies is a viral infection that mainly spreads through a bite from an infected animal. It is an RNA virus of the rhabdovirus family. Without early treatment, it is usually fatal.

Symptoms : In beginning flu-like symptoms like high fever, headache, anxiety, sore throat and a cough, nausea and vomiting etc. are seen in the patient but During Acute neurologic period patient show following symptoms.

1. Hallucinations and insomnia, Hypersalivation and possibly frothing at the mouth.
2. Partial paralysis, involuntary muscle twitching, and rigid neck muscles.
3. Fear of water, or hydrophobia, due to difficulty swallowing.

Control Measures : Individuals should follow some safety rules to reduce the chance of contracting rabies.

1. Regular anti-rabies vaccinations for all pets and domestic animals.
2. Some pets cannot be vaccinated, so they should be kept in a cage or inside the house to prevent contact with visitors.
3. Report strays animals to the local authorities.

146. Write about the names and five classes of antibody.

Ans : **OD 2016**

Antibodies are the antigen binding gly coproteins that are synthesized exclusively by *B*-cell. They are collectively called as immunoglobulins (Ig).

Five different types of immunoglobulins are known. These are as follows :

1. **IgG :** It is the most prevalent class of antibody that constitutes 75-80% of total antibody. This antibody give protection against fungi, bacteria, toxins etc. It can cross placenta from mother to child and provides immune protection to newborns.
2. **IgM :** They are first to be produced in response to encounter with a pathogen It is responsible for blood transfusion reactions in ABO blood system.
3. **IgA :** It is found in the body secretions from nose, eyes, lungs and digestive tract, saliva, tears, etc. It is also found in colostrum, i.e., breast milk for newborns to provide passive immune protection.
4. **IgE :** It make up to only 0.002% of total antibodies and is involved in allergic reactions.
5. **IgD :** It resembles IgG structurally and serves as a recognition receptor antigen.

147. Define the following terms:

1. Immunotherapy
2. Chemotherapy

Ans : **OD 2014**

1. **Immunotherapy :** It is also called as biological therapy. It is a type of cancer treatment that boosts the body's natural defences to fight cancer. It uses substances made by the body or in a laboratory to improve or restore immune system function. Immunotherapy may work by: Stop or slow the growth of cancer cells. It stop cancer from spreading to other parts of the body and help the immune system to work better at destroying cancer cells.
2. **Chemotherapy :** It is a type of cancer treatment that uses one or more anticancer drugs (chemotherapeutic agents) as part of a standardized chemotherapy regimen. Chemotherapy may be given with a curative intent, or it may aim to prolong life or to reduce symptoms.

NODIA

148. Write two symptoms of Aids.

Ans : **OD 2012**

Acquired Immuno Deficiency syndrome (AIDS) is a disorder caused by Human Immuno Deficiency Virus (HIV). HIV virus is a lentivirus, small sub group of retrovirus. The first case of AIDS was reported in california in 1981.

With in few weeks of HIV infection flu like symptoms such as fever, sore throat and fatigue can occur. Then, the disease is usually asymptomatic untill it progresses to AIDS. Its symptoms include weight loss, fever or night sweats, fatigue and recurrent infections.

149. Write on the roles of lymphocyte in immunity

Ans : **OD 2011**

Lymphocyte is a type of while blood cell that is part of the immune system. There are two main types of lymphocytes: B and T lymphocytes

1. **B Lymphocytes :** These lymphocytes play a key role in humoral immunity. These cells recognise foreign substance (antigen) and convert into plasma cells, that produce antibodies which destroy or kill antigens.
2. **T Lymphocytes :** These are cells that are programmed to recognize, respond to and remember antigens. T lymphocytes contribute

4. Experimentation.
5. To escape from stress.
6. Unsupportive family structure.

Control/prevention measures

1. Educating and counselling the child to face problems and stresses.
2. A child should not be pushed unduly to perform beyond his/her threshold limits.
3. Help can be taken from highly qualified psychologists, and de-addiction and rehabilitation programme, to help individuals who have got into the abuse of alcohol/drugs.

172. How do cellular barriers and cytokines barriers provide innate immunity in humans?

Ans : **COMP 2021**

Cellular barriers include the following specialized cells, which phagocytose and destroy the microbes:

1. Natural killer lymphocytes,
2. Neutrophils (Polymorpho-nuclear leucocytes, PMNL),
3. Monocytes, and
4. Macrophages.

Cytokine barriers include interferons produced by the viral-infected cells that protect the non-infected cells from viral infection.

173. Name and explain the two types of immune response in humans.

Ans : **DELHI 2022**

The two types of immune response are :

1. Primary immune response
   (i) The immune response that occurs as a result of the first encounter of the animal with an antigen is called primary immune response.
   (ii) It takes longer time to establish immunity.
   (iii) It declines rapidly.
2. Secondary immune response
   (i) The immune response that occurs at the second and subsequent encounters of the animal with the antigen, is called secondary immune response.
   (ii) It is more rapid and result in heightened immunity.
   (iii) It lasts for longer periods.

174. Name the two types of immunity in a human body. Why are cell-mediated and humoral immunities so called?

Ans : **SQP 2023**

Innate immunity and acquired immunity or Active immunity and passive immunity.

1. Cell-mediated immunity is so called because it involves specialized cells, the T-lymphocytes.
2. Humoral immunity is so called because it includes the antibodies, which are found circulating in the body fluid, the blood. (humours-body fluids)

175. Name the different types of cells that are responsible for producing the acquired immune response in a human body. How do these cells respond when a pathogen enters the body?

Ans : **COMP 2005**

B-lymphocytes and T-lymphocytes

1. Both these types of cells multiply and produce a clone of cells.
2. B-lymphocytes produce an array of proteins, called antibodies.
3. The T-lymphocytes stimulate the B-cells to produce antibodies.
4. Memory B-cells and T-cells remain in the body, for secondary immune response, in case of subsequent encounter by the pathogen.

176. Write the events that take place when a vaccine for any diseases is introduced into the human body.

Or

How does a vaccine for a particular disease immunise the human body against that disease?

Or

Name and explain the type of immunity that is provided by injecting microbes deliberately during immunisation into the human body.

Ans : **DELHI 2006**

1. Active immunity is produced by injecting the microbes deliberately during immunisation.
2. Antibodies are produced by the B-cells of our body in response to the antigens; they neutralise the pathogenic agents during actual infection.
3. The vaccines also generate memory B-cells and T-cells, which recognise the same pathogen on subsequent exposure and destroy them by a massive production of antibodies.

177. Mention the important functions or roles played by our immune system.

Ans : **OD 2009**

1. The immune system recognise foreign antigens and responds to them.
2. It keeps a memory of the antigen.
3. It plays an important role in autoimmune disease.

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154. What are the various public health measures which you would suggest as safeguard against infectious disease?

Ans : **FOREIGN 2023**

The common preventive measures are as follows:

1. **Education :** People should be educated about communicable diseases to protect themselves from such diseases.
2. **Isolation :** The infected person should be isolated to minimise the spread of infection.
3. **Vaccination :** The infected person should be isolated to minimise the spread of infection.
4. **Sanitation :** The sanitation condition should be improved to avoid infection from polluted water, contaminated food, etc.
5. **Eradication of vectors :** The breeding places of vectors should be destroyed and adult vectors should be killed by suitable methods.
6. **Sterilisation :** The patient's surroundings and articles of use should be completely sterilised so as to reduce the chance of infection.

155. Define congenital disease.

Ans : **OD 2009**

A birth defect, also known as a congenital disorder,is a condition present at birth regardless of its cause. Congenital disorders can be inherited or caused by environmental factors and their impact on a child's health and development can vary from mild to severe. A child with a congenital disorder may experience a disability or health problems throughout life. Some Common congenital disorders are : cleft lip and cleft palate, cerebral palsy, Down syndrome, Spina bifida, Cystic fibrosis, heart conditions.

156. In which way has the study of biology helped us to control infectious diseases?

Ans : **COMP 2021**

Study of biology helps us to diagnose the pathogen in following ways:

1. The life cycle of many pathogens is studied.
2. Alternate and reservoir hosts are known.
3. The mechanisms of transmission of disease is known.
4. The protective measures are suggested against disease and pathogen based on above studies.
5. Suitable medicines against infectious diseases are suggested.
6. The preparation of vaccines against many pathogens also entitle the use of study of biology.

157. How does the transmission of each of following diseases take place?

1. Amoebiasis
2. Malaria
3. Ascariasis
4. Pneumonia

Ans : **FOREIGN 2006**

1. **Amoebiasis**

   Caused by Entamoeba histolytica (Protozoan parasite).

   Transmission:

   (i) By ingesting cysts with food and water.
   (ii) The cysts are carried by flies from faeces to food and drinks.

2. **Malaria**

   Caused by Plasmodium sps.

   Transmission:

   (i) Transmitted by female anopheles mosquito.
   (ii) Female Anopheles injects sporozoites along with saliva while sucking blood.

3. **Ascariasis :** Caused by Ascaris lumbricoides. Is transmitted through contaminated food and water with Ascaris eggs.
4. **Pneumonia :** Caused by Streptococcus pneumoniae. Transmission is through sputum, droplets or aerosols of the patients.

158. Discuss with your teacher what does 'a suitable gene' mean, in the context of DNA vaccines.

Ans : **DELHI 2012**

The term 'suitable gene' refers to that specific segment of DNA which forms immunogenic protein. Such genes can be cloned and then integrated with vector for introducing into an individual to be immunised for certain disorder producing a particular vaccine against the pathogen.

159. What measures would you take to prevent water-borne diseases?

Ans : **OD 2010**

Measure to prevent water-borne disease are:

1. Use clean drinking water.
2. Periodic cleaning and disinfection of water reservoirs, pools and tanks.
3. Proper sanitary conditions.
4. Prevention of passage of garbage and sewage into water reservoirs.

160. Write down the difference between innate and acquired immunity

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to the immune defences in two major ways. Some direct and regulate the immune responses. When stimulated by the antigenic material presented by the macrophages, the T cells make lymphokines that signal other cells. Other T lymphocytes are able to destroy targeted cells on direct contact.

150. How does the transmission of malaria and pneumonia take place?

Ans : **OD 2011**

1. **Transmission of malaria :** Malaria is an insect born disease transmitted through the bite of an infected Anopheles mosquito that carry the plasmodium parasite. Malaria spreads when a mosquito infected with malaria parasites bites noninfected human. The parasites enter that person's bloodstream and migrate to the liver. When the parasites mature, they leave the liver and infect red blood cells. Mosquitoes become infected when they feed on infected people.
2. **Transmission of Pneumonia :** Pneumonia is an infection that inflames the air sacs in one or both lungs. The air sacs may fill with fluid or pus (purulent material), causing cough with phlegm or pus, fever, chills, and difficulty breathing. A variety of organisms, including bacteria, viruses and fungi, can cause pneumonia.

   Bacteria and viruses are the main causes of pneumonia. Pneumonia-causing germs settle in the alveoli and multiply after a person breathes them in Pneumonia can be contagious. The bacteria and viruses that cause pneumonia are usually inhaled. They can be passed on through coughing and sneezing, or spread onto shared objects through touch. The body send white blood cells to attack the infection. This is why the air sacs become inflamed. The bacteria and viruses fill the lung sacs with fluid and pus, causing pneumonia.

151. What do you mean by the term 'pathogen'?

Ans : **OD 2010**

Pathogens are microscopic organisms that cause or have the potential to cause disease. Different types of pathogens include bacteria, virus, protists (amoeba, plasmodium. etc.), fungi, parasitic worms (flatworms and roundworms), and prions. While these pathogens cause a variety of illness ranging from minor to life-threatening, it is important to note that not all microbes are pathogenic. In fact. the human body contains thousand of species of bacteria ,fungi, and protozoa that are part of its normal flora. These microbes are beneficial and important for proper operation of biological activities such as digestion and immune system function. They only cause problem when they colonize locations in the body that are immune system function. The only cause problem when they colonize locations in the body that are typically kept germ-free or when the immune system is compromised.

152. What are the effects of nicotine?

Ans : **OD 2010**

Nicotine is a chemical that contains nitrogen, which is made by several types of plants, including the tobacco plant. Nicotine is both a sedative and a stimulant. When a body is exposed to nicotine, the individual experiences a kick. This is partly caused by nicotine stimulating the adrenal glands, which results in the release of adrenaline. This surge of adrenaline stimulated the body. There is an immediate release of glucose as well as an increase in heart rate, breathing activity, and blood pressure. Nicotine also makes the pancreas produce less insulin, causing a slight increase in blood sugar or glucose. Indirectly, nicotine causes the release of dopamine in pleasure and motivation areas of the brain. A similar effect cocaine. The drug user experiences a pleasurable sensation.

153. Mention two applications of biotechnology in the field of medicine.

Ans : **OD 2009**

Two applications of biotechnology in the field of medicine are as follows :

1. **Gene Therapy :** Gene therapy is a collection of methods that allows correction of genetic defect that has been diagnosed in a child/ embryo. In it, faulty gene is replaced by a normal healthy functional gene.
2. **Vaccine production :** The production of vaccines against viruses, such as the herpes and hepatitis virus (second generation vaccines) involves the use of genetic engineering. Genes that code for part of the protein or polysaccharide coat of the herpes simplex virus or the hepatitis-B virus are inserted into vector such as vaccinia virus and then transferred into cultured mammalian cells that Generate numerous copies of the recombinant virus, which has the outside coat of a herpes or hepatitis virus.

NODIA

166. List the harmful effects caused by alcohol/drug abuse.

Ans : **DELHI 2016**

The following are the harmful effects caused by alcohol/drug abuse:

1. It affects the nervous system resulting in loss of judgement, will power and self-control, visual problem, etc.
2. It may cause peptic ulcer, gastric carcinoma, etc.
3. It may cause peptic ulcer, gastric carcinoma, etc.
4. Reckless behaviour, vandalism and violence, isolation, depression, fatigue, aggressive, fluctuations in weight, appetite, etc.
5. Those who take drugs intravenously are much more likely to acquire serious infections like AIDS and hepatitis-B.
6. Damages nervous system and may cause liver cirrhosis.

167. Mention some methods of treatment of cancer.

Ans : **DELHI 2007**

Methods of Treatment of Cancer : The exact cause of cancer is not known and there are no effective drugs to cure cancer. Although there are some methods to treat cancer which are given below:

1. **Radiotherapy :** Cancerous cells are destroyed by the use of X-rays.
2. **Surgical Removal :** The cancerous tissue is cut during the primary stage and it checks the growth of spreading the cancerous cells in breast, lungs, Kidney, ovaries and skin.
3. **Chemotherapy :** Cancerous cells are destroyed by the drug called Taxol. It is used to cure Hodkin's disease (a form of Leukaemia). Anticancer drugs are Vincrisitin and Vinblastin. They are used to cure Leukaemia.

168. Do you think that friends can influence one to take alcohol/drugs? If yes, how may one protect himself/herself from such an influence?

Ans : **SQP 2009**

Yes, friends can influence one to take alcohol drugs.

1. Educating and counselling the child to face problems and stresses and accept disappointments and failures as part of life.
2. A child should not be pushed unduly to perform beyond his/her threshold limits.
3. Alert parents and teachers need to look for and identify the danger signs and then appropriate measures should be taken to diagnose the malady and the underlying causes.
4. Help can be taken from highly qualified psychologists, psychiatrists and de-addiction and rehabilitation programmes, to help individuals who have got into the abuse of alcohol/drugs.

169. Name the primary and secondary lymphoid organs.

Ans : **OD 2018**

1. **Primary Lymphoid Organs :** These are bone marrow and Thymus gland. Here the immature lymphocytes differentiate into the antigen sensitive lymphocytes. Then after maturation, they move to secondary lymphoid organs.

   Bone marrow provides micro environment for development and maturation of B-lymphocytes.

   Thymus provides micro-environment for development as well as maturation of T-lymphocytes.
2. **Secondary Lymphoid Organs :** These include lymph nodes, spleen, tonsils, peyer's patches of small intestine and the appendix. These provide site for interaction between the antigens and the lymphocytes.

   Spleen has lymphocytes and phagocytes.

170. Why is that once a person starts taking alcohol or drugs, it is difficult to get rid of this habit? Discuss it with your teacher.

Ans : **OD 2011**

1. Addiction is a psychological attachment to certain effects-such as euphoria and a temporary feeing of well-being associated with drugs and alcohol.
2. Due to the addiction potential of these drugs/ alcohol, the user is inclined to use them again and again for the pleasures he has experienced.
3. With repeated use, the tolerance level of the drug receptors in the body increases and they respond only to higher doses.
4. So it leads to an increased intake of drugs and addiction; hence, it is difficult to give up the habit.

171. In your view, what motivates youngsters to take alcohol or drugs and how can this be avoided?

Ans : **FOREIGN 2015**

Causes for drug abuse

1. Curiosity
2. Need for adventure
3. Need for excitement.

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2. Smoking also increases the CO content in blood and reduces the concentration of haembound oxygen, thus causing oxygen deficiency in the body.
3. Chewing of tobacco causes cancer of oral cavity.
4. Nicotine, an alkaloid present in tobacco, stimulates the adrenal glands to secrete adrenaline and nor-adrenaline, which increase the blood pressure and heart rate.

186. What is 'withdrawal syndrome? List any two symptoms it is characterised by.

Ans : **SQP 2008**

These are the characteristics and unpleasant manifestations of the body, when regular does of drugs/alcohol is abruptly discontinued.

The symptoms of withdrawal syndrome are as follows:

1. Anxiety
2. Excess sweating
3. Shakiness
4. Nausea

In some cases, withdrawal symptoms can be severe and even life-threatening.

187. Due to undue peer pressure, a group of adolescents started using opioids intravenously. What are the serous problems they might face in future?

Ans : **DELHI 2010**

1. They are more likely to get infections like AIDS and hepatitis-B, as the viruses of these diseases are spread by the use of contaminated needles and syringes; both are chronic infections and are fatal.
2. Since, the tolerance levels of the receptors present in our body to these drugs increases, they respond only to higher doses of drugs leading to greater intake and addiction.

188. How does the pathogen gain entry into the human body? Write the diagnostic symptoms and mention the body organ that gets affected in severe cases.

Ans : **DELHI 2016**

The pathogen enters the human body through contaminated food and water.

Symptoms

Symptoms of typhoid include :

1. Sustained of typhoid fever $(39 - 40^{\circ}C)$
2. loss of appetite
3. Stomach pain
4. Headache and weakness
5. Intestinal perforation in severe cases may cause death.

Intestine gets affected in severe cases.

189. Mention the characteristic symptoms of Dengue fever. How is the disease transmitted to others?

Ans : **SQP 2020**

The symptoms of dengue fever :

1. Fever
2. Headache
3. Muscle and joints pain
4. Characteristic skin rashes
5. Decrease is transmitted by Aedes mosquito.

190. A patient is down with Amoebiasis. List the symptoms that confirm this infection. Name the causative pathogen.

Or

1. Name the agent that causes amoebiasis and the human body organ that it infects.
2. Write the symptoms and the mode of transmission of the disease.

Or

Mention the name of the causal organism, symptoms and the mode of transmission of the disease. Amoebiasis.

Ans : **FOREIGN 2021**

1. Amoebiasis is caused by Entamoeba histolytica.
2. Symptoms
   (i) Constipation.
   (ii) Abdominal cramps and pain.
   (iii) Stool with excess mucus and blood clots.

Transmission

(i) Drinking water and food contaminated with the faeces of infected person.

(ii) Houseflies act as mechanical carriers and transmit the parasite from faeces to food and water.

191. Name the form of Plasmodium that gains entry into the human body. Explain the different stages of the life cycle in the human body.

Or

Name the stage of the Plasmodium that is transmitted to human body by the vector. Describe the life cycle of the parasite in humans.

Or

Trace the life cycle of malarial parasite in the human body, when bitten by an infected female Anopheles.

Or

Give the scientific name of the parasite that causes malignant malaria in humans. At what stage does this parasite enter the human body? Trace its life cycle is human body.

NODIA

4. It is responsible for the allergic reactions.
5. It decides the suitability of organ transplantation.

178. Describe the role of lymph nodes in providing immunity.

Ans : SQP 2010

1. The lymph nodes serve to trap the micro-organisms and other antigens which have entered the lymph and tissue fluid.
2. These trapped antigens activate the lymphocytes present in the lymph nodes to cause immune response.

179. Where do the lymphocytes produced by the lymphoid organ mentioned above, migrate and how do they effect immunity?

Ans : FOREIGN 2016

(i) Some of the lymphocytes remain in the bone marrow and mature into B-lymphocytes.
(ii) B-lymphocytes produce antibodies, that neutralise the neutralise the pathogen during actual infection.
(iii) Some of the lymphocyte move to the thymus and mature into T-lymphocytes.
(iv) T-lymphocytes stimulate B-cells to produce antibodies and some T-cells are involved in cell-mediated immunity and are responsible for rejecting organ transplants.

180. How do macrophages in the human body act as 'HIV Factory'?

Ans : COMP 2017

1. After entering the macrophage, the RNA of the virus produces DNA catalysed by the enzyme reverse transcriptase.
2. This viral DNA gets incorporated into the DNA of the host cell or macrophage and directs the host cell to produce virus particles.
3. The macrophage continues to produce new virus and thus, acts as a HIV factory.

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181. Differentiate between benign and malignant tumours.

Ans : SQP 2018

The difference benign and malignant tumours are as follows :

	Benign Tumours	Malignant Tumours
1.	These are the tumours which remain confined to their original location.	These are the tumours whose neoplastic cells are separate and move to other sites.
2.	These tumours cause little damage to the body.	They cause more damage to the body.
3.	Metastasis is not shown.	Metastasis is the important feature,

182. Explain metastasis. Why is it fatal?

Ans : FOREIGN 2013

Metastasis is the property of neoplastic or cancerous cells by which the cancerous cells sloughed off from a tumour reach distant sites through body fluids and establish a new tumour, wherever they get lodged.
It is fatal because the treatments like radiation therapy or surgery cannot be carried out at any particular location.

183. State the effect of carcinogens on human body. Name the carcinogenic ionising and non-ionising radiations. Mention their carcinogenic effect.

Ans : OD 2011

Carcinogens induce transformation of normal cells into neoplastic cells.
Carcinogenic ionizing radiation; e.g. X-rays and carcinogenic non-ionising radiation e.g. UV-rays, cause damage to DNA that leads to transformation of these normal cells into neoplastic cells.

184. Name the plant source of cocaine. How does it affect the human body?

Ans : COMP 2009

Cocaine is obtained from the plant Erythroxylon coca.

1. It interferes with the transport of neurotransmitter, dopamine.
2. It has a stimulating action on the central nervous system and produces a sense of euphoria and increased energy.
3. Excess of it causes hallucination.

185. Why is using tobacco in any form injurious to health? Explain.

Ans : OD 2007

1. Smoking of tobacco is associated with cancer of lungs, urinary bladder and throat, bronchitis, emphysema, coronary heart diseases, etc.

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Ans : SQP 2016

The difference between Innate immunity and Acquired immunity are as follows :

	Innate immunity	Acquired immunity
1.	It is present from birth and is inherited from parents.	It is not present from the birth.
2.	It is non-specific.	It is pathogen specific.
3.	The various physical, physiological, cellular, cytokine barriers are the basis of innate immunity.	The memory cells formed by B and T-cells are the basis of acquired immunity.
4.	The innate immunity remains throughout life.	The acquired immunity can be short-lived or life long.

161. Write down the difference between active and passive immunity

Ans : COMP 2012

The difference between Active and passive immunity are as follows :

	Active immunity	Passive immunity
1.	It is developed due to contact with pathogen (dead or living) or its antigen, that leads to production of antibodies in the host body.	It is developed when ready made antibodies are injected into the body.
2.	It has no or only few side effects.	It may cause a reaction.
3.	It is slow but long lasting.	It is fast but lasts only for few days.
4.	It takes time to develop its response.	It is used when the immune response has to be faster.
5.	For example, vaccination for polio, etc.	For example, administration of tetanus antitoxins, antibodies in colostrum, etc.

162. What are the various routes by which transmission of human immunodeficiency virus takes place?

Ans : SQP 2017

Various routes by which transmission of HIV takes place:

1. Transfusion of contaminated blood and blood products.
2. By sharing infected needles in case of intravenous drug abusers.
3. Sexual contact with an infected person.
4. From mother to child through placenta.

163. What is the mechanism by which the AIDS virus causes deficiency in the immune system of the infected person?

Ans : FOREIGN 2020

The virus enters macrophages after getting into the body of individual where RNA forms viral DNA by reverse transcription. The viral DNA gets incorporated in the host cell's DNA and directs the infected cells to produce viral copies. The newly produced virus particles attack helper T-cells and thus the number of T-cells decreases. Since the helper T-cells are essential for functioning of immune system, the person suffers from various diseases due to deficient immune system.

164. How is a cancerous cell different from a normal cell?

Ans : COMP 2023

1. There is no adherence in cancerous cell whereas normal cells remain adhered to one another.
2. Tumour is formed in cancerous cells due to repeated uncontrolled cell division whereas it is absent in normal cells.
3. Cancerous cells have no definite lifespan but normal cells have definite lifespan and old cells are replaced by new cells.

165. Explain what is meant by metastasis.

Ans : OD 2013

Metastasis is the spread of cancerous cells through migration from one tissue to other tissue and organs resulting in formation of secondary tumour. Malignant tumour is a mass of proliferating cells called neoplastic cells. They grow rapidly and invade surrounding unaffected normal cells or tissues. Cells get sloughed off from such tumour and migrate to distant sites through blood. A new place of infection is thus established and a new tumour is formed. This property is called metastasis.

NODIA

Ans : **DELHI 2015**

Life cycle of Plasmodium in human body

1. When an infected female Anopheles mosquito bites a person, the sporozoites are injected into the body.
2. They reach the liver cells through blood.
3. The parasite reproduces asexually in the liver cells and by the bursting of liver cells, new cells are released into the blood.
4. They enter the red blood cells (RBCs) and reproduce asexually by bursting the red blood cells, the cells of the parasite release haemozoin, which causes the cycle of fever, chill and shivering.
5. The released parasite cells infect new red blood cells; Some continue the asexual reproduction and cause the cycles of fever.
6. Others enter the sexual stage and form gametocytes in the RBCs, which are picked by the Anopheles mosquito, along with the blood meal.

192. Name the causative organisms for the following diseases:

(i) Elephantiasis

(ii) Ringworm

(iii) Amoebiasis

Ans : **FOREIGN 2009**

(i) Wuchereria bancrofti and Wuchereria malayi.

(ii) Trichophyton,Microsporum,Epidermophyton.

(iii) Emtamoeba histolytica.

193. Trace the stage of Plasmodium in the body of female Anopheles after its entry.

Ans : **COMP 2016**

Plasmodium picks up the gametocytes along with the blood meal.

↓

Gametocytes reach the intestinal cells of mosquito; fertilisation occurs here.

↓

Zygote develops and produces sporozoites in the intestine.

↓

Sporozoites escape from the intestine and reach the salivary glands, where they remain stored.

194. Mention any two human disease caused by roundworms. Name their causative agents and their mode of transmission into the human body.

Ans : **OD 2023**

1. Ascariasis
   (i) It is caused by Ascaris lumbricoides.
   (ii) It is transmitted by water, fruits and vegetable contaminated by the cysts of parasite from the faeces of infected persons.
2. Filariasis
   (i) It is caused by Wuchereria bancrofti and W.Malayi.
   (ii) It is transmitted by Culex mosquito.

195. A person is suffering from ringworm disease. Mention the pathogen and the part of the human body affected. Give two symptoms of the disease along with two modes of transmissions.

Ans : **SQP 2021**

Ringworm is caused by Microsporum, Trichophyton and Epidermophyton.

1. Skin, nails and scalp are affected.

Symptoms

1. Dry, scaly lesions on body parts like skin, scalp and nails.
2. The lesions are accompained by intense itching.

Trasmission

1. By contact with the articles (like towels, comb, clothes, etc.) used by the infected person.
2. From soil, by direct contact.

196. How can public hygiene help to control such diseases?

Ans : **OD 2013**

Proper disposal of wastes can help to control these diseases, where the garbage dumps act as breeding grounds for the mechanical carriers (like housefly) or vectors (female culex mosquitoes) are vectors for filariasis.

Disinfectants used in the soil can help to control the fungal pathogens.

197. Why are lymph nodes and bone marrow called lymphoid organs? Explain the functions of each of them.

Ans : **COMP 2011**

1. Since lymph nodes and bone marrow are the organs where origin and/or maturation and proliferation of lymphocytes occur, they are called lymphoid organs.

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2. Lymph nodes serve to trap the micro-organisms or other antigens that enter the lymph; the lymphocytes in the lymph are then activated by these foreign molecules/ organisms to mount an immune response.
3. Bone marrow is the primary lymphoid organ where lymphocytes are produced.

198. Name and explain giving reasons, the type of immunity provided to the new born by the colostrum and vaccination.

Ans : **FOREIGN 2020**

Colostrum provides passive immunity because it contains preformed antibodies (IgA).

Vaccination provides active immunity; the vaccine injected into the body contains the antigen (weakened/killed/live pathogens or their antigenic polypeptides) and the antibodies are produced by the body cells.

199. How do benign tumours turn malignant? How does the latter harm the human body?

Ans : **DELHI 2015**

When the cells of a (benign) tumour separate, reach distant sites through body fluids and get lodged there and start new tumour there, it is called malignant.

(i) These cells damage the surrounding normal tissues.

(ii) They compete with the normal cells and starve them of vital nutrients.

200. Mention six causes of drug abuse.

Ans : **FOREIGN 2018**

The causes of drug abuse are:

1. Curiosity
2. Need for adventure and excitement
3. Experimentation
4. Stress from pressures to excel in academics/ sports
5. Peer pressure
6. Unsupportive family.

201. What causes some viruses cause cancer in humans?

Ans : **SQP 2023**

The cancer causing viruses, called oncogenic viruses, have genes called viral oncogenes. When these genes that have entered out body cells are activated under certain conditions, could lead to oncogenic transformation of cells, i.e., cancer is caused.

NODIA

202. 'Prevention is better than cure' is an apt slogan to safeguard adolescents from drug abuse. List any six steps that could be taken in this regard.

Ans : **SQP 2019**

1. A child should not be pushed unduly to perform beyond his/her threshold limits in studies, sports or any other activities.
2. Educating and counselling him/her to face problems and stresses and accept disappointments and failures as part of life.
3. Parents and teachers can identify the danger signs and take appropriate steps to diagnose the malady and underlying causes, so that proper remedial steps can be taken.
4. Help can/should be sought from qualified psychologists, psychiatrists, and de-addiction and rehabilitation programmes.
5. The individual an seek help from parents and teachers.
6. Help can also be sought from close friends; this would help to vent the feeling and anxiety and guilt.

203. When someone buys packets of cigarettes, cannot miss the statutory warning that is present on the packing which warns against smoking and says how it is injurious to health. Yet, smoking is very prevalent in our society, both among young and old. Advise the adolescents about the importance of avoiding smoking. (Mention any six points).

Ans : **DELHI 2018**

Smoking must be avoided as it causes the following ill-effects:

1. Tobacco contains a number of harmful chemicals, of which nicotine is an alkaloid, a stimulant and a poison,
2. Nicotine stimulates the adrenal glands to secrete adrenaline and noradrenaline, both of which increase the blood pressure and the heart rate.
3. It leads to cancer of throat, lungs and urinary bladder.
4. Smoking also causes respiratory disorders like bronchitis and emphysema.
5. It causes oxygen deficiency in the body by increasing the carbon monoxide content in the blood and reducing the concentration of haem-bound oxygen.
6. It causes gastric ulcers and increased risk of coronary heart diseases.

LONG ANSWER QUESTIONS

204. What is Acquired Immunodeficiency Syndrome? Give an account of its pathogen, transmission etiology, diagnosis and remedy. Suggest measures for its prevention.

Or

Describe the causes, symptoms and prevention of AIDS.

Ans : OD 2018

Acquired Immuno Deficiency syndrome (AIDS) is a disorder caused by human immuno deficiency Virus (HIV). The first case of AIDS was reported in california in 1981.

1. **Pathogen :** HIV virus is a lentivirus, small sub group of retrovirus. It is enveloped within a memberane, which is made up of several Gp 120 and Gp 41 glycoproteins. These are present in the form of spikes all over the surface of virus The central part or Core of HIV is composed of two single stranded RNA reverse transcriptase enzyme, P-15 protein associated with RNA inner covering of P-24 and outer covering of P-28.
2. **Transmission of AIDS (Etiology) :** There are three main ways by which AIDS is transmitted among population.
   (i) Unsafe sexual act about 65% of HIV infection takes place through this route.
   (ii) Transmission through blood transfusion and contaminated equipments like contaminated needles or syringes, razor etc.
   (iii) Transmission from infected mother to her developing foetus.
3. **Symptoms of AIDS :** Acquired Immuno Deficiency syndrome (AIDS) is a disorder caused by human immuno defeciency Virus (HIV). HIV virus is a lentivirus, small sub group of retrovirus. The first case of AIDS was reported in california in 1981.

   With in few weeks of HIV infection flu like symptoms such as fever, sore throat and fatigue can occur. Then, the disease is usually asymptomatic untill it progresses to AIDS. Its symptoms include weight loss, fever or night sweats, fatigue and recurrent infections.
4. **Diagnosis :** Various test can be performed to diagnose HIV infection e.g. ELISA, PCR, western blot test etc.
5. **Remedy :** Several drugs such as azidothymidine (AZT), stavudine (DUT) dideoxy- cytidine (DDC), dideoxyinosine (DDI) are used for treatement of AIDS. All these drugs block the conversion of retroviral RNA to gene as they are nucleotide analogues. Drugs belonging to protease inhibitor category interfere with the protein processing steps of HIV capsid. They include saquinavir, indinavir and ritonavir.
6. **Preventive Measures :** AIDS infection can be prevented by following given practises.
   (i) Use of condoms or barrier methods for safe sex.
   (ii) Use of sterilised needles and syringes.
   (iii) Blades, razors and dental equipments should be sterilized before use.
   (iv) HIV test must be performed, before donating or accepting blood.
   (v) Proper knowledge of the disease should be given to people to create awareness.

205. What are the basic principles of Immunology and their application?

Ans : OD 2017

Immune system is an adaptive defence system of vertebrates that has evolved to protect them from invading pathogenic micro organisms and cancer. It is able to generate an enormous variety of cells and molecules capable of specifically recognizing and eliminating an apparently limit less variety of foreign invaders.

Functionally, an immune response can be divided into two related activities, recognition and response. The immune system is able to recognise subtle chemical differences that distinguish one foreign pathogen from another. It can also discriminate between foreign molecules and body's own cells and proteins. Once a foreign organism has been recognised, the immune system enlists the participation of variety of cells and molecules to mount an appropriate response, called an effector response, to eliminate or neutralize the organism. Later exposure to the same foreign organisms induces a memory response, which is characterised by more rapid and heightened immune reaction that serves to eliminate the pathogen and prevent disease. The state of protection from infectious disease is called as Immunity. It can be broadly classified into two types.

1. **Innate (non-specific) Immunity :** It is a type of immunity that is not specific to particular pathogen. It is present from the time of birth and inherited from parents.

   It consists of different types of barrier systems that prevents the entry of pathogens or antigen into the body. These barriers may be physical

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The immune system produces antibodies against the invaders called the antigens. Antigens are generally large molecules, the majority of which are proteins or polysaccharides . Many allergens (drugs, chemicals, feathers, pollens, vegetables, transplants etc.) can trigger immune system.

220. Explain the types of Tumour and Cancer.

Ans : **FOREIGN 2012**

1. **Types of Tumour :** The tumours are of two types:
   (i) **Benign of Tumour :** These remain confined to their original location.
   (ii) **Malignant Tumours :** They are those tumours which grow quickly and are invasive.
2. **Types of Cancer :**
   (i) **Carcinoma :** The malignant growth of epithelial tissues, that are ectodermal in origin. Examples are lung cancer and breast cancer.
   (ii) **Sarcoma :** The malignant growth of tissues which are mesodermal in origin. Examples are tumour of bones.
   (iii) **Leukaemia :** It is malignant growth of blood cells as well as their precursors.
   (iv) **Melanomas :** These are malignant growth of melanocytes (a type of cells present in skin).

221. Describe the main effects of alcohol drinking in human beings.

Ans : **OD 2011**

Alcohol drinking has many ill-effects on human body. Some of them are given below:

1. **Amnesis :** Loss of memory.
2. **Gastritis :** It is the inflammation of stomach. Gastric ulcer may be formed in some cases.
3. Body resistance is reduced.
4. It affects control and co-ordination of body.
5. **Hypoglycemia :** Blood sugar level is lowered.
6. It effects the family and social life of man.
7. It affects judgements, alertness and vision. Automobile accidents are caused in this condition.
8. **Liver :** It is badly affected due to alcoholism. Excess of alcohol in blood increases the synthesis of fat. This fat is deposited in the liver cells and the bile ducts. It affects protein and carbohydrate metabolism resulting in fatty liver syndrome. More severe effect is cirrhosis of liver and bilary cirrhosis which may prove fatal in due course.

222. How would you test HIV infection in human beings?

Ans : **DELHI 2008**

Test for HIV infection : It is done by ELISA TEST. A test to detect the presence of antibodies, formed against AIDS have been developed. The presence of HIV-III antibodies in the blood of a person shows that he or she was infected by that virus. But this test does not prove that the person is still infected without virus. If the test is positive, it should be considered that the person is able to spread virus to other persons.

1. Human serum and antigen coated bead is put in a test tube. HIV-I antibodies will bind to the bead even if it is washed.
2. Then in colour reaction a conjugated antibody enzyme is mixed in the test tube. It will bind to first antibody.
3. The colour change is compared to known negative test (where antibody HIV-I is lacking) and then to a known positive test,

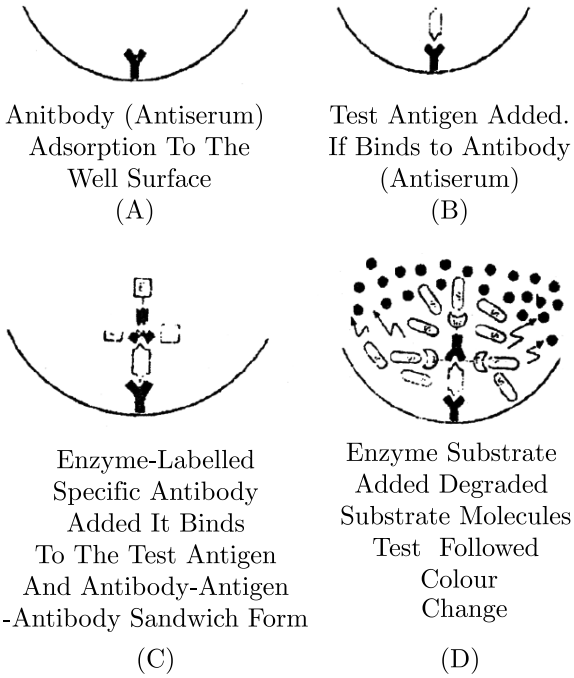

Fig ELISA

223. Explain briefly the characteristics of cancer cells.

Ans : **COMP 2010**

Characteristics of cancer cells : The cancer cells show the following characteristics :

1. The nucleus of cancerous cells may have virus, lipids, proteins and glycogens.

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2. Avoid salads, raw fish and uncooked vegetables.
3. Ensure that food is thoroughly cooked.
4. Make sure water is bottled or boiled and safe to consume.
5. Avoid street food, as this can carry cholera and other diseases.

208. What is tuberculosis? For which bacteria is it caused? Write about is control.

Ans : **FOREIGN 2011**

Tuberculosis (TB) is an infection of the lungs and respiratory system, which is the organ system that allows us to breathe. This disease was first discovered by Robert Koch thus, it is also called as, koch's disease. TB is caused by a bacterium called Mycobacterium tuberculosis. It spreads from person to person when an infected person coughs, sneezes, laughs, or spits. Tiny droplets of fluid from the lungs are carried in the air and can be breathed in by someone nearby. Although it can affect many parts of the body, TB usually occurs in the lungs.

On the basis of pattern of infection tuberculosis is divided into primary tuberculosis and secondary tubnerculosis. Primary tuberculosis is found as initial infection usually in children. The initial infection is a small subpleural granuloma accompanied by granulomatous hilar lymph node infection.

Secondary tuberculosis is found mostly in adults as a reactivation of previous infection particularly when health status declines. When resistance to infection is particularly poor, a miliary pattern of spread can occur in which there are a myraid of small millet seed sized granulomas either in lung or other organ.

Symptoms These are high fever, sweating, loss of weight, cough, difficulty in breathing, blood in sputum and acute pain. Sputum is laden with the bacteria in case of pulmonary TB.

Control and treatment : Antituberculosis drugs like streptomycin, isomazid, thiacetazone, ethambatol, pyrazinamide, rifampicin, etc., prove effective.

The full treatment generally last for 6 months which should not be stopped or broken, because the bacteria develop resistance to the drugs. Vaccination with Bacillus Calmette Guerin (BCG) vaccine provides immunity. **DOTS**(Directly Observed Treatment-a short course) is the new strategy to combat the disease. It ensures that like patient takes the full course of the treatment and does not stop it midway.

209. What do you understand by vaccination and immunization?

Or

Write a note on vaccination and immunisation.

Ans : **OD 2012**

A vaccine is a biological preparation that provides active acquired immunity to a particular disease. A vaccine typically contains an agent that resembles a disease causing micro organism and is often made from weakened or killed forms of the microbe, its toxins, or one of its surface proteins. The agent stimulates the body's immune system to recognize the agent as a threat, destroy it, and to further recognize and destroy any of the micro organisms associated with that agent that it may encounter in the future. The administration of vaccines is called vaccination.

Mechanism of Action of Vaccines :

Vaccines help to develop immunity by imitating an infection. This type of infection, however, does not cause illness, but it does cause the immune system to produce T-lymphocytes and antibodies. Sometimes, after getting a vaccine, the imitation infection can cause minor symptoms, such as fever. Such minor symptoms are normal and should be expected as the body builds immunity. Once the imitation infection goes away, the body is left with a supply of "memory" T-lymphocytes, as well as B-lymphocytes that will remember how to fight that disease in the future. However, it typically takes a few weeks for the body to produce T-lymphocytes and B-lymphocytes after vaccination. Therefore it is possible that a person who was infected with a disease just before or just after vaccination could develop symptoms and get a disease, because the vaccine has not had enough time to provide protection.

Classification of Vaccines : There are five main types of vaccines used to develop immunity in human beings.

1. **Live, attenuated vaccines :** These contain a version of the living virus that has been weakend so that it does not cause serious disease in people with healthy immune systems. Examples measles, mumps and rubella vaccine (MMR) and varicella (chickenpox) vaccine etc.
2. **Inact ivated Vaccines :** These vaccines are made by inactivating, or killing, the virus during the process of making the vaccine. e.g. polio vaccine.
3. **Toxoid Vaccines :** Toxoid vaccines prevent disease caused by bacteria that produce toxins (poisons) in the body. In the process of making these vaccines, the toxins are weakend

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barriers such as anatomical, physiological, inflammatory and phagocytic etc. The skin produces secretion. Acidity of stomach kills mircobes. Lysozyme digests cells walls of bacteria entering the body. Phagocytes eat foreign matter. Most cells release histamine and prostaglandins. Natural killer cells kill virus infected cells.

2. **Rh Blood Group :** Rhesus blood group is due to a cell surface antigen. It was first inverted by Rhesus monkey. Persons with Rh factor are Rh-positive while Rh negative donor have this antigen. Rh antigen form a strong immunogenic response when introduced into Rh negative persons. It is very essential in blood transfusion as it is related to HDN (haemo-lytic disease of new born). In order to prevent HDN, Rh negative mothers are injected with a defective anti Rh negative antibody during all pregnancies carrying Rh positive foetus.
3. **Organ Transplants :** The success of organ transplants depends upon the proper matching of his to compatibility antigens that are found in all the cells of body. Chromosomnes-6 of mouse has a cluster of genes called major histocompatibility complex. In humans it is known as HLA (human leucocyte antigen). The alleles of HLA are contaminant. Their products determine the histocompatibility. It is done by tissue typing.
4. **Vaccination :** the principle of vaccination is based on the memory of immune system. In it the preparation of antigenic proteins of pathogens or weakened pathogen/Vaccine is introduced into the body. These antigen generate primary immune response and memory B and T-cells. When vaccinated person is attached by the same pathogen, the existing B and T cells recognize the antigen and produce antibodies and lymphocytes.

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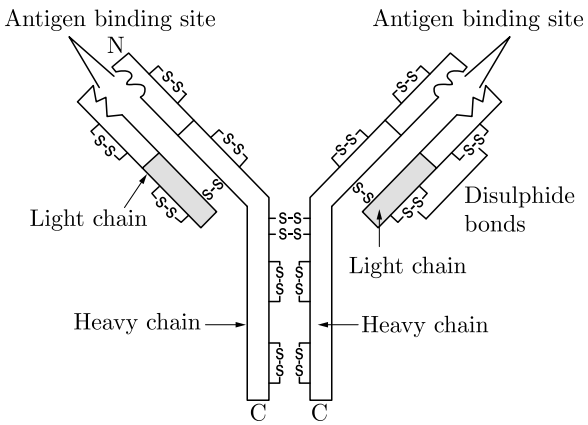
226. Describe the structure of immunoglobulin Ig/ antibody. Draw a diagram showing the formation of antigen-antibody complex and label the parts.

Ans : **2022**

Antibodies : Antibody is designated by H_2L_2. They are found in blood so they form humoral immune response. The antibodies may function as monomers. IgA, IgM can occur both as monomers and polymers. IgA, IgD, IgE, IgG and IgM, are five classes of immunoglobins :

1. **IgA (Secretory Immunoglobins) :** Present in all body secretions including mother's milk, colostrum, tears and saliva. If takes part in activating alternate pathway. This pathway of complement system is activated even without the presence of antibody-antigen complex. IgA is the first line of defence which enables a person to fight against invading microorganisms before becoming sensitised. IgA is effective against a number of antigens, particularly the ones containing polysaccharides. Its molecular weight is 160,000.
2. **IgD :** It is found in small quantity in serum tissue and is effective against toxins and allergens. Alongwith IgM, it appears on the surface of B-cells as antigen 6 receptor; formed of a delta peptide chains.
3. **IgE :** This is concentrated in Skin, mucous membranes and lungs. It triggers off immediate hypersensitive reactions on contact with antigens. It attaches to basophils and mast cells. The cells are induced to release histamine and other inflammatory substances.
4. **IgG :** These are about 75% of the total antibodies. It can pass through placenta. It is present in all parts of the body but is more abundant in blood, lymph and intestine. It has subtypes. IgG molecules stimulate alternate pathway of complement system and act as opsonins. They are toxins. It is found in serum.



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212. Describe briefly immune system in the body.

Ans : **DELHI 2017**

Body encounters numerous infectious agents every day. However only a few of these exposures result in disease. Body defends itself from these pathogens. This ability of the body to fight the disease causing organisms is called immunity. Immunity is the functional ability of out immune system.

Human immune system is formed of lymphoid organs, tissues, cells and molecule like antibodies.

Lymphoid organs : In these organs, origin and or maturation and proliferation of lymphocytes occur. These are of two types. Primary lymphoid organs and secondary lymphoid organs.

1. **Primary lymphoid organs :** Bone marrow and thymus are the primary lymphoid organs. In bone marrow all types of blood cells are formed. In both bone marrow and thymus immature lymphocytes differentiate into antigen sensitive lymphocytes and after this migrate into the secondary lymphoid organs. Both bone marrow and thymus provide micro-environments for the development and maturation of T-lymphocytes. Thymus gland located above the heart is quite large at the time of birth but go on reducing with age. At puberty it becomes very small sized.
2. **Secondary lymphoid organs :** Spleen, lymph nodes, tonsils, Peyer's patches of small intertive and appendix are the secondary lymphoid organs.

   Secondary lymphoid organs provides sites for interaction of lymphocytes with the antigens. Spleen is a large bean shaped organ and contains lymphocytes and phagocytes in it. It also acts as a filter of the blood for traping micro-organisms present in the blood. It also acts as a reservoir of red blood cells. Lymph nodes serve to trap micro-organisms from the lymph and tissue fluid. Microorganisms traped in lymph nodes, activates lymphocytes present there and cause the immune response. Tonsils present in the neck region, Peyer's patches of small intestine and appendix, all are formed of lymphoid tissue containing lymphocytes, which destroy microbes. Mucosa associated lymphoid tissue (MALT) located within the lining of the major body tracts such as respiratory, digestive, and urinogenital. It constitute about 50 percent of the total lymphoid tissue in human body.

213. What is immunity? Give a brief account of innate immunity?

Ans : **SQP 2020**

Immunity is defined as the overall ability of the organisms body to fight the disease causing organisms.

Immunity is of two types :

1. Innate immunity,
2. Acquired or adaptive immunity

Innate immunity : Immunity present at the time of birth is called innate immunity. Innate immunity is non-specific type of defence. This immunity is exhibited by the body by providing different types of barriers to check the entry of foreign agents in it.

The following four types of barriers of innate immunity are :

(i) Physical barriers; (ii) Physiological barriers; (ii) Cellular barriers; and (iv) Cytokine barriers.

(i) **Physical barriers :** Skin and mucus coating of different body tracts act as barriers to check the entry of microorganisms in the body. Skin is the main barriers.

(ii) **Physiological barriers :** Saliva secreted by salivary glands in the oral cavity, tears from the eyes contain a antibacterial enzyme lysozyme to kill bacteria. Acid (HCl) of gastric juice secreted in stomach also kill bacteria etc. to prevent microbial growth in the body.

(iii) **Cellular barriers :** While blood cells of our body act as soldiers of defend the body from microbes. Leucoytes like polymorphonuclear leuucoytes (PMNL-neutrophils) and monocytes and natural killers (type of lymphocytes) in the blood as well as macrophages in tissues like liver, spleen phagocytose and destroy, the invading microbes.

(iv) **Cytokine barriers :** Viruses intracellular parasites. Virus infected cells secrete interferons. Interferons protect non-infeected cells from further viral infection.

214. It is said that "Some drugs when taken in combination with alcohol and some other produce much more dangerous effects." Give some examples.

Ans : **OD 2023**

Yes, it is true.

Interaction of Alcohol with Some Common Drugs:

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so they cannot cause illness. Weakened toxins are called toxoids. The DTAP vaccine contains diphtheria and tetanus toxoids.

4. **Subunit Vaccines :** Include only parts of the virus or bacteria, or submits, instead of the entire germ. The pertussis (whooping cough) component of the DTAP vaccine is an example of a subunit vaccine.
5. **Conjugate Vaccines :** Fight a different types of bacteria. These bacteria have antigens with an outer coating of sugar-like substances called polysaccharides. This type of coating disguises the antigen, making it hard for a young child's immature immune system to recognize it and respond to it. Conjugate vaccines are effective for these types of bacteria because they connect (or conjugate) the polysaccharides to antigens that immune system responds to very well. This linkage helps the immature immune system react to the coating and develop an immune response. Example Haemophilus influenzae type B (Hib) vaccine.

210. Describe the structure of an antibody.

Ans : **COMP 2016**

B-lymphocytes produce an army of globular proteins in response to pathogens into our blood to fight with them. These globular proteins are called immunoglobulins. or antibodies. Structurally each antibody molecule has four peptide chains, two identical small chains called light chains and two larger identical called heavy chains. Hence, an antibody is represented by H_2L_2. Along half the molecular, Carbohydrate groups are attached. The two heavy chains in the body are held together by a series of disulphide bonds. Along the other half, the chains are aligned in two pairs, with one heavy and one light chain in each pair. The entire molecule of an antibody is shaped like a Y.

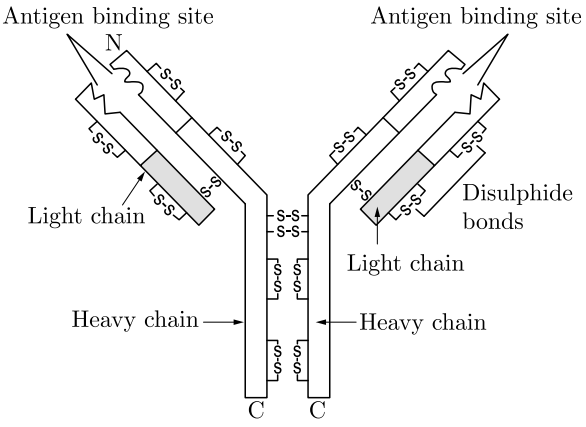

Fig Structure of an antibody

Each heavy and light chain have a variable region (V_1) and a constant region (C_1) Variable region of an antibody is formed of unique sequence of amino acids. These unique sequences, are the reason of different types of antibodies produced to counter specific antigen (each-antigen has its own antibody). This variable regions form the active site or the antigen binding sites.

Thus, each antibody can bind to two same antigens. Constant regions in all the kinds of antibodies are similar and provides effector functions to antibodies.

211. Give a brief account of causes, symptoms and treatment of cancer.

Ans : **OD 2019**

Cancer : In body's normal cells, cell growth and differentiation is highly controlled and regulated. But when due to various reasons there is a breakdown of these regulatory mechanisms, normal cells change into cancerous cells. These cells continue to divide giving rise to masses of cells called tumors.

Causes of Cancer : Exert cause of cancer is not clear yet. Many factors are known to favour the development of cancer or the transformation of normal cells into cancerous ones. These factors are called carcinogenic agents or carcinogens. Some of these possible carcinogens are :

1. X-rays, gamma ray (ionizing radiations) and non-ionizing radiations like UV cause damage to DNA leading to cancerous (neoplastic) transformation.
2. Chemical carcinogen like present in tobacco smoke have been identified as a major cause of lung cancer.
3. Biological agents like certain cancer causing viruses called oncogenic viruses have genes called viral oncogenes cause cancer.
4. Cellular oncogenes or protoncogenes are found in normal cells of all living organisms which when activated under certain conditions could lead to cancer.

Symptoms of Cancer : Possible symptoms of cancer are:

1. Any wound that does not heal in a normal time.
2. Persistant indigestion, changes in bladder or bowel habits, cough etc.
3. Unexplained low-grade fever, loss of weight.

Treatment of Cancer : The common approaches for treatment of cancer are :

1. Surgery.
2. Radiation therapy.
3. Immunotherapy.

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	Infectious Diseases	Non-Infectious Diseases
1.	These are caused by the entry of disease germs or pathogens in the body of an organisms	These are not transmitted from one person to another person through any agency.
2.	These germs are transmitted from one patient through direct or indirect contact through contaminated clothes, food, bedding, utensils or through an agent vector which may be an organism. The pathogens causing communicable diseases may be viral, bacterial, protozoan, fungal or helminthic.	They may be caused by (a) Deficiency of any essential dietary constituent in the food, i.e., vitamin, mineral, proteins etc. (b) General degeneration of tissue due to old age. (c) Uncontrolled growth in any part of body. (d) Defect in metabolism. (e) Injury to any part of body.

218.1. A woman was tested positive for AIDS. Name the pathogen that infected her. How does this pathogen weaken her immune system? Explain.

Or

How does AIDS virus enter the human body? Describe its life cycle. Why does this infection shatter the immunity of the victim?

2. Trace the events that occur in human body to causes immuno deficiency when HIV gains entry into the body.

Ans : **DELHI 2008**

1. See the chart as:
   (a) HIV enters macrophage.
   (b) The viral genome DNA replication occurs into DNA by reverse transcriptase enzyme.
   (c) The viral DNA incorporation into the host DNA.
   (d) The viral DNA directs the infected cell to form virus particles.
   (e) The virus comes out but the infected cells continues to produces HIV particles.
   (f) The new HIV particles begin to infect Helper T (T_H) cells that causes reduction in the number of T_H cells.

2. Human Immuno Defriciency Virus (HIV). See chart also.

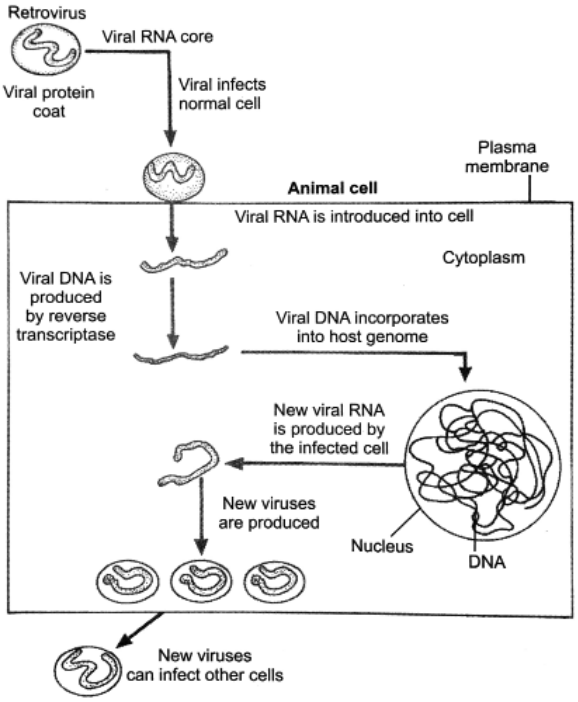

Fig Flow chart to depict the multiplication of an HIV virus in a host cells

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219. Name the two types of immune systems in a human body. Why are cell mediated and humoral immunities so called?

Ans : **SQP 2019**

Immune System : The immune system is divisible into two components :

(i) humoral system and (ii) cell mediated immune (CMI) system. The key words of this system is that it distinguishes between self and non-self.

1. **The Humoral System :** It consists of many proteins called antibodies which continuously circulate in the body fluids. This system defends against viruses and bacteria that invade blood and lymph.
2. The Cell-Mediated System is carried out of highly specialised called with work against transplants. It is also believed to protect the body from cancers.

(skin, hair on the body), physiological (saliva and tears), cellular (WBCs) or cytokines like interferons.

2. **Adaptive or Specific or Acquired Immunity :** It is the immunity acquired after birth by an individual during their lifetime.

   The specific immunity may be active or passive.

   (i) **Active Immunity :** It is produced by the body on exposure to antigen. It is developed within the body of an individual due to previous encounter with the antigen Or can also be achieved through vaccination,

   (ii) **Passive Immunity :** It is a type of Immunity developed due to direct transfer of actively formed antibodies.

206. Write about the malarial fever, its causes, symptoms, control and prevention.

Ans : **OD 2016**

Malaria is protozoan disease caused by plasmodium species. This pathogen is transmitted by female anopheles mosquito.

Cause of malaria : Malaria is protozoa disease which spread due to mosquito bite.

1. **Causative organism :** There are four species of plasmodium which cause four different types of malaria in human. Plasmodium vivax cause benign tertian malaria; P. malaria cause quartan malaria P. falciparum cause cerebral malaria and P. ovale cause mild tertain malaria.
2. **Mode of transmission :** Malaria is transmitted by mosquitoes. When female anopheles mosquito bites an infected person, the malaria parasite enter into the mosquito's body and under go further development to form sporozoites that finally move to the salivary glands of the insect. When mosquito bite a healthy person, these sporozoites migrate into blood stream of new host and cause the infection.
3. **Symptoms :** Tiredness, headache, muscular pain, chill and shivering and high fever.
4. **Therapy :** Antiparasite and Antibiotic drugs are given to the patient.

Symptoms : Person suffering from malaria show influenza like symptoms such as shaking chills, headache, muscle ache, nausea, vomiting, diarrhoea etc. It can also cause anaemia and jaundice.

Control and prevention : The primary cause of malaria is its vector mosquito that transmit this pathogen from diseased person to healthy person so, it is important to check their growth in surrounding area. This can be done either by killing mosquitoes by spraying DDT, BHC etc or by avoiding, their contact by using mosquito repellents, mosquito nets etc. Along with it is suggested to wear full cover clothes while sleeping or visiting affected areas. It is important to keep our surrounding neat and clean, not allowing mosquitoes to get breeding areas e.g. keep sanitary lined closed, fill ditches with mud, don't allow rain water to fill in any empty container etc.

207. Write short notes on the following:

Causes, symptoms and control cholera.

Ans : **OD 2015**

Cholera is an infectious disease that causes serves watery diarrhea, which can lead to dehydration and even death if untreated. It is caused by eating food or drinking water contaminated with a bacterium called Vibrio cholera.

Causes : cholera is mostly Transmitted by Faecal Oral Route. Cholera is more common where there is overcrowding and poor sanitation. Cholera bacteria enter the body through the mouth, often in food or water that has been contaminated with human waste, due to poor sanitation and hygiene. They can also enter by eating seafood that is raw or not completely cooked, in particular shellfish native to estuary environments, such as oysters or crabs. Poorly cleaned vegetables irrigated by contaminated water sources are another common source of infection.

Signs and Symptoms : The patient starts passing stools frequently, which are white like rice water, and gets repeated vomiting. The disease can be diagnosed by the microscopic examination of the stool or the vomit when the typical comma-shaped cholera vibrio's can be seen.

Treatment : It is normally dehydration that leads to death from cholera, so the most important treatment is to give oral hydration solution (ORS), also known as oral rehydration therapy (ORT). The treatment consists of large volumes of water mixed with a blend of sugar and salts. Severe cases of cholera require intravenous fluid replacement.

Prevention : Cholera is often spread through food and because of poor hygiene. Some simple measures can reduce the risk of contracting cholera.

1. Eat only fruit you have peeled.

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2. The golgi complex of cancer cells is developed considerably. Ribosomes are more in number in cancer cells.
3. In the cytoplasm of thyroid cancer cells colloidal substance is found .
4. In cancer cells the cytoskeleton is disorganised and disintegrated.
5. Neoplastic cells multiply indefinitely.
6. The cellular adhesion is decreased in skin cancer cells.
7. Cancerous cells need very low concentration of serum.
8. The secretion of proteolytic enzymes is increased in cancer cells.
9. The rate of glycolysis is high in tumour cells due to injury to the aerobic respiratory system.

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224. How is specific immunity generated in our body? Why is specific immunity considered to be unique in its function? Write any four features of this type of immunity.

Ans : **SQP 2015**

Adaptive Immunity : It is called specific or acquired immunity.

1. **Activation of Adaptive Immunity :** Each antigen is processed by macrophages and B-lymphocytes. It is found on the surface of cells. T-helper cells interact with presented antigen to become excited. Activated T-helper cells active B-cells and T-cytotoxic cells in a particular manner. These activated B and T cytotoxic cells proliferate produce clones and all the cells of this clone recognize the same antigen and then eliminate it.
2. **Clonal Selection :** The B and T lymphocytes display on their surfaces specific receptor. Receptor is antibody in case of B-cell. This receptor reacts to antigenic determinant specific to it, the lymphocyte is activated then and divides to make a clone of cells. These cells transform into effector cells i.e., antigen forming B-cells and T-cytotoxic cells. This process is called clonal selection when all the cells of a clone come from one parent. But same develop into memory cells.
3. **Role in Vaccination :** The principle of vaccination is mainly based on the characteristics of memory of the immune system. In the preparation of antigenic proteins of pathogens or vaccine is introduced into the body. These antigens generated primary immune response and the memory of B and T cells. If the vaccinated person is attacked

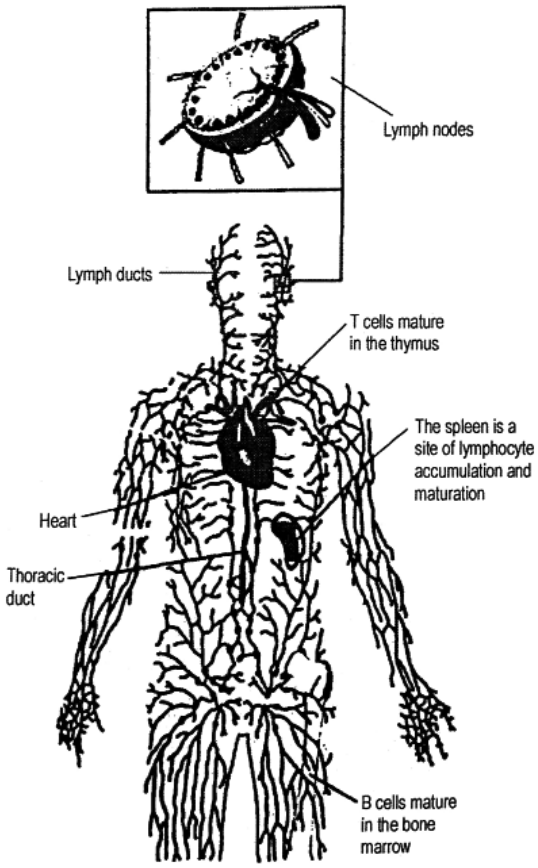

Fig Human lymphatic system

by the same pathogen, the existing T or B cells recognize the antigen quickly. These overwhelm the invaders with excessive production of antibodies and lymphocytes.

225. Explain the following in not more than 100 words:

1. Innate immunity
2. Rh blood groups
3. Organ transplants
4. Vaccination.

Ans : **FOREIGN 2012**

1. **Innate immunity :** It is called non specific immunity. It includes all the elements present at the time of birth. It is always present to project the body. It consists of many

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	Drugs	Effects
1.	Alcohol and other depressants e.g., Barbiturates.	Dramatically increased depressants effects.
2.	Alcohol + antihista mines.	Marked drowsiness (normally little or no sedative effect).
3.	Alcohol + Valium	Rapid increase in sedative effect; often dramatic.
4.	Alcohol + marijuana or hashish.	Decreased coordination, increased reaction time, impaired judgement.
5.	Alcohol + Aspirin.	Increased risk of damage to gastric mucosa.
6.	Alcohol Benzodiazapenes.	Rapid increase in sedative effect ; often dramatic.
7.	Benzodiazapenes and Barbiturates.	Increases Sedation.
8.	Amphetamine + Insulin.	Insulin effect is decreased.
9.	Necotine + Cocaine	Increased cardiovascular effects.
10.	Antidepressant and Cocaine.	Hypertension.

215. 1. Write the scientific names of the two species of filaria worms causing filariasis.
2. How do they affect the body of infected persons(s)?
3. How does the diseases spread ?

Or

Write the scientific names of the casual organisms of elephantiasis and ringworm in humans. Mention the body parts affected by them.

Ans : **FOREIGN 2012**

1. **Filariasis :** W.bancrofit and W.malayi (filaria worms) cause chronic inflammation of the organs in human beings. In the lymphatic vessels of the lower limbs the disease is called Elephantiasis or Filariasis.
2. **Symptoms :** The genital organs are also affected, leading in gross deformities.
3. **Spread of Disease :** Pathogens are transmitted to a healthy person through bite by female mosquito that serves as a vector.

Cause : The filaria worm (wuchereria bancrofti) lives in lymphatic vessels and lymph glands and causes filariasis.

Ringworm in humans is caused by fungi like Microspermum, Trichophyton and Epidermophyton etc.

Dry scaly lesions appear on the sinks, nails, sclap and other body parts of human beings.

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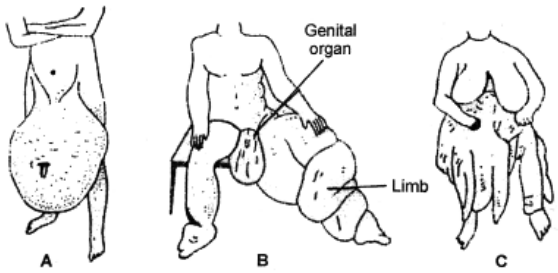

Fig Persons suffering from Elephantiasis (Filariasis)

216. Name and explain briefly some disorder caused due to smoking in human beings.

Ans : **COMP 2009**

Tobacco smoking causes many disorders in human beings. Some of them are given below :

1. **Bronchitis :** It is the inflammation of alveoli in the lungs and the respiratory tract.
2. **Heart Disease :** Nicotine in tobacco smoke increases heart beat rate in human beings. It causes high blood pressure of hypertension. The lumen of blood vessels become narrow.
3. **Intestinal Ulcer :** Smoking causes ulcer in the intestine.
4. **Emphysema :** Mucous is deposited in alveoli of lungs and gaseous exchanges is reduced.
5. **Lung Cancer :** Polycyclic aromatic hydrocarbons present in tobacco smoke cause cancer of lungs.

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217. Enlist the differences between infectious and non-infectious diseases.

Ans : **COMP 2014**

The differences between infectious and non-infectious diseases area as follows :

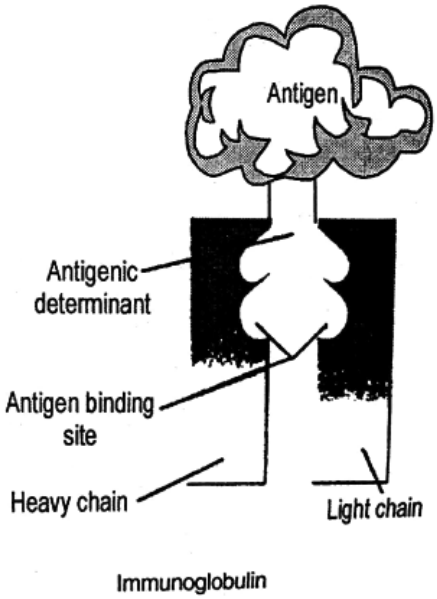

Fig (a), (b) Structure of a typical antibody

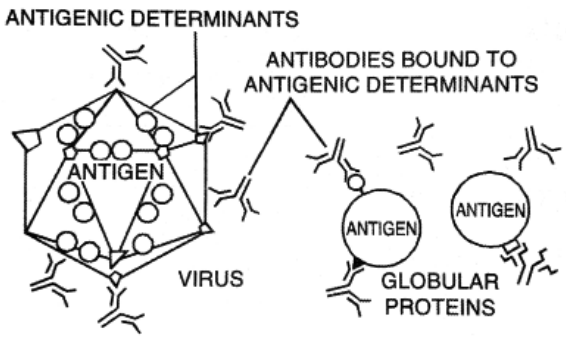

Fig Formation of antigen-antibody complex

5. **IgM :** Largest of the antibodies having small number. It is the first to reach the site infection. There are binding sites the antibody is highly effective. It stimulates IgG production and alongwith IgG, IgM activates the pathway of complement system.

227. How would you perform widal test? Explain briefly.

Ans : **OD 2019**

Widel Test : The stained salmonella antigens are used to detect and identify specific antibody in serum samples from patients suffering from enteric fever or typhoid. These antigens are used in the Widal test. They can also be used as control antigen while carrying out serological identification of bacterial isolates from clinical specimens.

Principle : Antibodies in serum, formed in response to exposure while carrying out serological identification of bacterial suspension which carry homologous antigens.

Rapid Slide (screening) Test:

Step I : Wash the glass slide in the kit well. Wipe that free of water.

Step II : Put one drop of undiluted test serum in each of the first circles (1 to 4) and one drop of positive control serum in each of the last two circle (5 to 6).

Step III : Put one drop of antigens O.H.A(H) and B(H) in circle 1,2,3 and 4 respectively and O antigen in circle 5 and any one of the H antigens [H, A(H), B(H) in circle 6].

Step IV : Mix the contents of each circle with separate wooden stick and spread to fill the whole area of the individual circle.

Step V : Rotate slide for two minutes. Now observe the agglutination.

Precautions to be taken while performing the widal Test :

1. Keep all the reagents at room temperature before use.
2. Use clean and dry glassware/slides.
3. For greater proficiency in the slates interpretation of test result, always include positive and negative control sera.
4. Serum samples should be clear, free from any bacterial contamination (not be heated or inactivated).

CASE BASED QUESTIONS

228. Spermatogenesis is an important primary sex characteristic in humans and all other vertebrates. The process is coordinated and controlled under the influence of hormones. It starts with the onset of puberty in humans and thereafter continues. The primordial cells within the embryonic testis which differentiate into spermatogonia are the precursors of the sperms. These are located at the outer walls of the seminiferous tubules where the process of spermatogenesis proceeds.

(i) State the site of action of FSH in the testes and describe its action thereafter.

(ii) Describe the role of LH in the process of spermatogenesis.

(iii) Name the cells and their products which undergo:
(a) Mitosis and Differentiation
(b) Meiosis I and Meiosis II
during the process of spermatogenesis.

(iv) Name the accessory ducts that the sperms travel through from seminiferous tubules to reach the epididymis.

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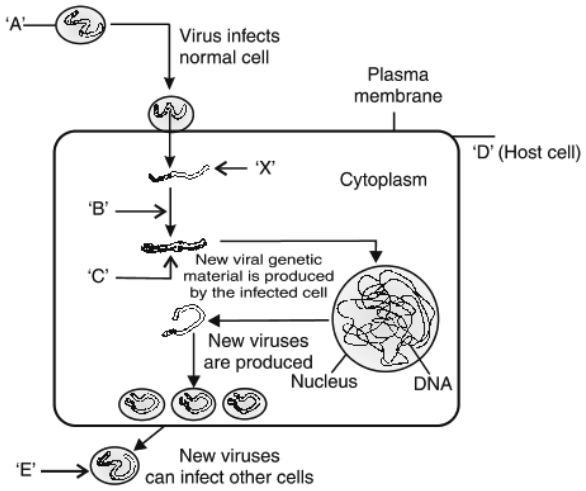
(iv) Chemical carcinogens present in tobacco smoke are the major cause of lung cancer due to chemical present in tobacco. The cigarette smoke also causes emphysema as it irritates the air passages of the lungs causing them to produce mucus which causes cough resulting collapse or alveolar septa which greatly reduces the surface area for gas exchange. Walls of alveolar sac loses elasticity and thus alveolar sacs remain filled with air even after expiration.

233. Study the diagram showing replication of HIV in humans and answer the following questions accordingly.



(i) Write the chemical nature of the coat 'A'.

(ii) Name the enzyme 'B' acting on 'X' to produce molecule 'C'. Name 'C'.

(iii) Mention the name of the host cell 'D' the HIV attacks first when it enters into the human body. How does HIV differ from a bacteriophage

(iv) Name the two different cells the new viruses 'E' subsequently attack. What are two ways of transmission of HIV infection in humans other than sexual contact.

Ans :

(i) A - Protein coat

(ii) B - Reverse transcriptase
C - Viral DNA

(iii) D - Macrophage. HIV has single stranded RNA as genetic material while bacteriophage has dsDNA.

(iv) E - Macrophages and T-lymphocytes. Other than sexual contact, transmission of HIV infection in humans could also occur by

(a) Transfusion of contaminated blood and blood products.

(b) From infected mother to her child through placenta.

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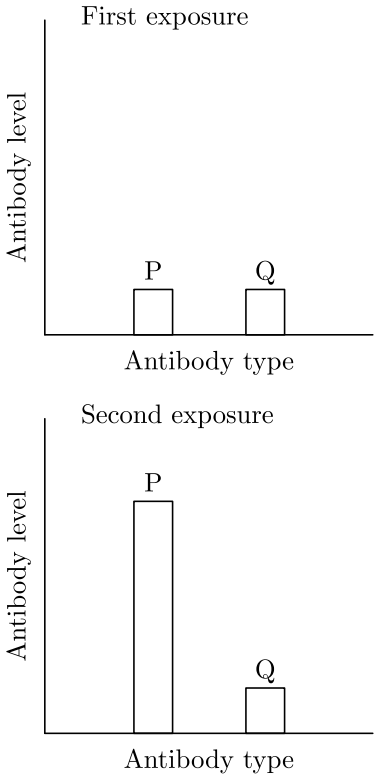
234. In a study to test a new vaccine against a viral disease, mouse model testing is done. In this process, mice are vaccinated and their blood samples were tested. Mice developed mild disease symptoms. After few days those mice were again infected with the virus. This time they did not show any disease symptoms. Their blood samples were tested. Two graphs given show antibody concentration for the first and second infection in mice blood.



(i) Identify P and Q in the given graphs.

(ii) Which form of pathogen is used in vaccination?

(iii) Write the characteristics of P.

(iv) Why mice did not show any disease symptoms during second exposure to the pathogen virus?

Ans :

(i) P is I_gG and Q is I_gM. Initial contact with an antigen causes primary immune response. In primary immune response, no antibodies are present initially. Then, a slow rise in the antibody titer occurs, first IgM and then IgG, followed by a gradual decline in antibody titer. In secondary immune response, the

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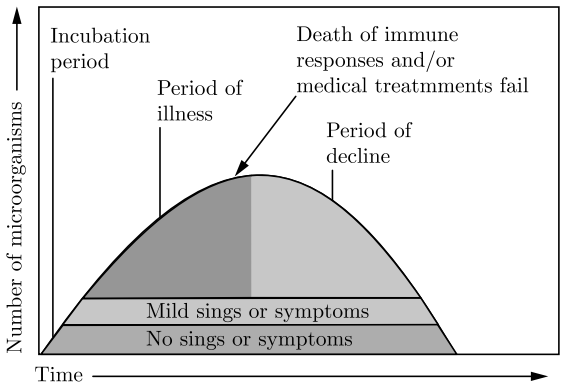
231. When a microorganism invades a host, a defmite sequence of events usually occur leading to infection and disease, causing suffering to the host. This process is called pathogenesis. Once a microorganism overcomes the defense system of the host, development of the disease follows a certain sequence of events as shown in the graph. Study the graph given below for the sequence of events leading to appearance of a disease and answer the questions that follow :



(i) In which period, according to the graph there are maximum chances of a person transmitting a disease / infection and why ?

(ii) Study the graph and write what is an incubation period. Name a sexually transmitted disease that can be easily transmitted during this period. Name the specific type of lymphocytes that are attacked by the pathogen of this disease.

(iii) Draw a schematic labelled diagram of an antibody.

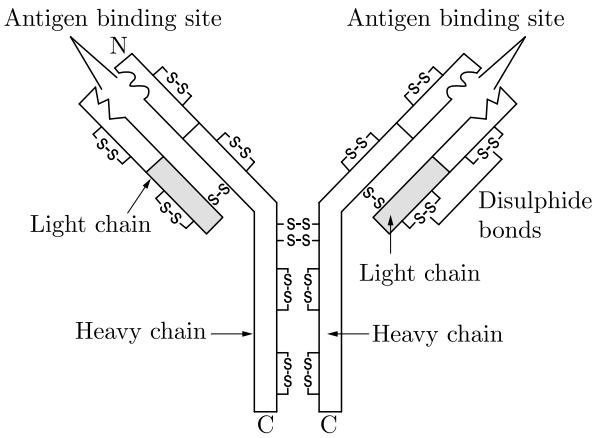
(iv) In which period, the number of immune cells forming antibodies will be the highest in a person suffering from pneumonia ?
Name the immune cells that produce antibodies.

Ans : **SQP 2023**

(i) (a) Incubation period
(b) Infected person may not take precautions during this period as there are no symptoms of the diseases.
(c) Period of illness
(d) Number of microorganisms is high and can be transmitted via droplet infection.

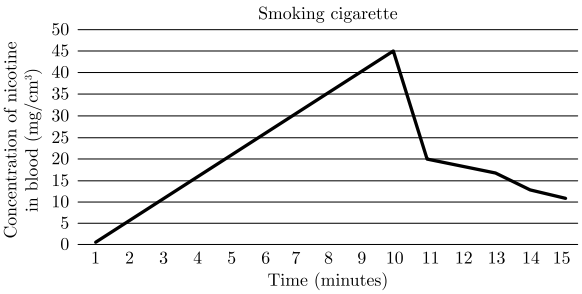
(ii) (a) Time period between infection and appearance of its symptoms.
(b) AIDS/any other correct example
(c) T lymphocytes

(iii)



(iv) (a) Period of illness
(b) B lymphocytes / B cells

232. The data below shows the concentration of nicotine smoked by a smoker taking 10 puffs/ minute.



(i) With reference to the above graph explain the concentration of nicotine in blood at 10 minutes.

(ii) How will this affect the concentration of carbon monoxide and haembound oxygen at 10 minutes?

(iii) How does cigarette smoking result in high blood pressure and increase in heart rate?

(iv) How does cigarette smoking result in lung cancer and emphysema?

Ans :

(i) Concentration of nicotine is maximum at 10 minutes where concentration of nicotine increases steadily in the blood to reach 45 mg/cm^3.

(ii) The concentration of CO will increase resulting in reduced concentration of haembound oxygen.

(iii) Nicotine results in stimulating the adrenal gland which results in release of adrenaline/ nor - adrenaline in the blood resulting in increase of blood pressure and heart rate.

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Ans : **DELHI 2024**

(i) Sertoli cells in seminiferous tubule, induces release of some factors which induce spermiogenesis.

(ii) LH acts on Leydig cells, and stimulates the synthesis and secretion of androgens for spermatogenesis.

(iii) (a) Spermatogonia $\xrightarrow{mitosis/differentiation}$ Primary Spermatocyte

(b) Primary Spermatocyte $\xrightarrow{meiosis\ I}$ Secondary Spermatocyte $\xrightarrow{meiosis\ II}$ Spermatid

(iv) Rete testis, vasa efferentia

229. In 1981, the health workers of United States of America had become aware of the increased frequency of Kaposi's sarcoma, cancer of the skin and blood vessels and another disease pneumocystis pneumonia, a respiratory infection caused by a protozoan. Both these diseases were very rare in the general population, but occurred frequently in more severely immunosuppressed individuals. This led to the recognition of the immune system disorder that was named Acquired Immune Deficiency Syndrome (AIDS).

In 1983, virologists working in the USA and France had identified a causative agent for 'AIDS',.now know as Human Immunodeficiency Virus (HIV). 'HIV' follows a set path to attack the human body to cause the disease.

(i) Name the group of cells the HIV attacks after gaining entry into the human body and write the various events that occur within this cell.

(ii) Write the expanded form of the diagnostic test used for detecting AIDS. Write the possible treatment available for the disease at present.

(iii) Mention any two steps suggested by WHO for preventing the spread of this disease.

(iv) A patient suffering from AIDS does not die of this disease but from some other infection. Justify the statement.

Ans : **COMP 2024**

(i) (a) Macrophages
(b) virus replication (RNA genome)

(ii) Enzyme-linked immuno-sorbent assay (ELISA)/Polymerase Chain Reaction (PCR)
Treatment available – Antiviral drugs that are only partially effective as they only prolong the life of the patient.

(iii) Making blood HIV safe in blood banks, use of only disposable needles and syringes in hospitals, free distribution of condoms, controlling drug abuse, advocating safe sex, regular check-ups for HIV susceptible population. (any two)

(iv) This is because of drastic reduction of helper T-lymphocytes that are responsible to fight infections,
-person become immune-deficient,
-unable to protect oneself from other bacterial or viral or fungal or parasitic infection

230. "Mosquitoes are drastically affecting the human health in almost all the developing tropical countries. Different species of mosquitoes cause very fatal diseases so much so that many humans loose their life and if they survive, are unable to put in productive hours to sustain their life. With the result the health index of the country goes down.

(i) Name the form in which Plasmodium gains entry into (a) human body, (b) the female Anopheles body.

(ii) Why do the symptoms of malaria not appear in a person immediately after being bitten by an infected female Anopheles ? Give one reason. Explain when and how do the symptoms of the disease would appear.

(iii) Explain the events which occur within a female Anopheles mosquito after it has sucked blood from a malaria patient.

(iv) Name a species of mosquito other than female Anopheles and the disease, for which it carries the pathogen.

Ans : **OD 2024**

(i) (a) Sporozoites, (b) gametocytes

(ii) (a) The sporozoites after entering the body need to undergo asexual reproduction in liver and RBC
(b) RBC burst, released haemozoin which is responsible for chill and high fever recurring every 3-4 days.

(iii) Gametocytes (male and female) enter female mosquito body via blood meal, fertilization in gut / stomach, sporozoites escape from the gut, and migrate into salivary glands (of mosquito)

(iv) *Aedes*, – dengue / chikungunya or *Culex*, – filariasis or elephantiasis (Any other correct example with disease can be considered)

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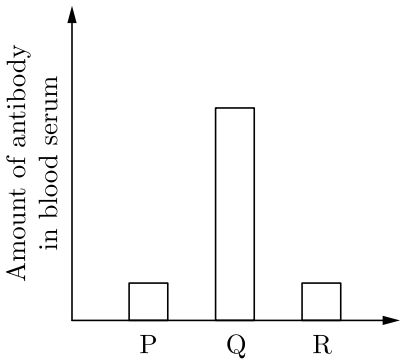
antibody formation is accelerated and more intense. This is also called booster response. It mainly consists of IgG antibodies.

(ii) Vaccine is a preparation or extract of an inactivated attenuated (weakened) pathogen of a disease which on inoculation into a healthy person provides immunity by inducing antibodies production.

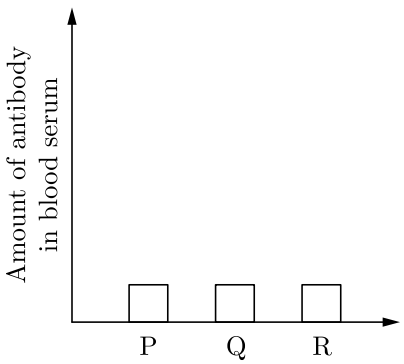
(iii) P is the most abundant class of immunoglobulins IgG. It is a monomer and found in blood and all body

(iv) Mice did not show any disease symptom during second exposure to the pathogen virus because the antibody production is accelerated and more intense during secondary immune response.

235. The graphs below show the result of blood tests of a person X during illness (Graph I) and after recovering (Graph II).



Graph I



Graph II

(i) With reference to the above graphs, what will you inferred about the disease in a person X?

(ii) What would be the possible explanation with regards to no change in antibody type P and R in both the graphs I and II.?

(iii) Which antibody type among P, Q and R confirms that the person X is suffered from infection and how?

(iv) If person X has contracted with an allergen, then which type of antibody will be produced in his body?

Ans :

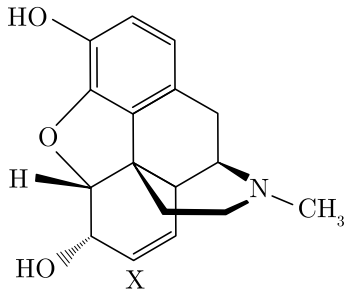
(i) The person X is suffered only from the pathogenic infection for which his body produced antibody Q.

(ii) The person X might be vaccinated or had contracted the actual diseases in his life for which his body produced antibodies P and R.

(iii) The level of antibody type Q confirms that the person X is suffered from infection since its level decreases after recovering (Graph II.)

(iv) Allergies mainly involve IgE antibodies and chemicals like histamine and serotonin from mast cells.

236. After a surgery drug 'X' was injected to the patient to counteract the effect of pain receptors in the body and to induce sleep in patient. The structure of the drug 'X' is provided :



X

(i) Identify the drug from the chemical structure that was injected to the patient.

(ii) Give the scientific name of the plant that can be used to obtain drug X.

(iii) Write the effects of compound obtained by drug X on the human body.

(iv) To which group X belongs to? Mention the location of its receptors in human body.

Ans :

(i) Drug X is morphine that acts as an analgesic (painkiller).

(ii) Morphine (X) is extracted from the latex of poppy plant, Papaver somniferum.

(iii) Heroin is obtained from the poppy plant (Papaver somniferum). It is obtained by acetylation of morphine which is extracted from the latex of poppy plant. Some of the effects of heroin on the human body are as follows :

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Ans :

(i) *Wuchereria* (W *bancrofti* and *W. malayi*), the filarial worms cause filariasis or elephantiasis in humans.

(ii) They develop a slowly developing chronic inflammation of the organs in which they live for many years.

(iii) Inflammation in the lymphatic vessels of the lower limbs, the genital organs are also often affected, resulting in gross deformities.

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239. Study the two cases carefully regarding the pattern of inheritance of disease.

Case	Mother	Father	Children
Case I	With disease	Normal	Sons always with diseases
Case II	With disease	Normal	Sons and daughters could show disease

(i) Give two examples of case I diseases.

(ii) On which chromosome case I diseases are present on?

(iii) If inheritance pattern of disease is as case II and both parents are carrier of disease then what are the chances of pregnancy resulting in an affected child?

(iv) The possibility of a human female suffering from a hemophilia disease is rare. Why is it so?

Ans :

(i) Case I shows sex-linked recessive diseases, e.g., Haemophilia and colour-blindness.

(ii) Sex-linked recessive diseases (Case I) are present on X-chromosome.

(iii) Case II shows auto somal inheritance. If both the parents are carrier, then it must be a case of autosomal recessive inheritance where the chances of having a disease child is 25% as shown :

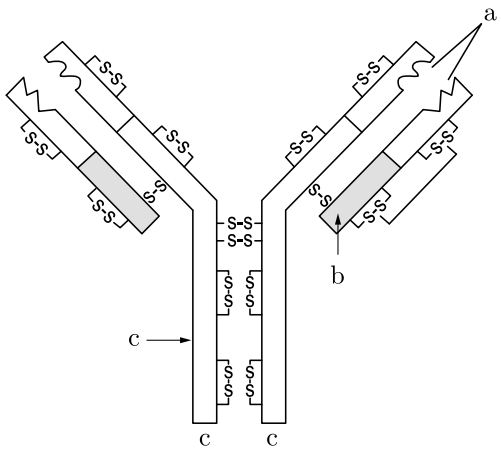
Parents : ♀ Aa × ♂ Aa

Offspring :

♀ \ ♂	A	a
A	AA Normal	Aa Carrier
a	Aa Carrier	aa Affected

(iv) Haemophilia (case I) is transmitted genetically due to the presence of a recessive sex linked gene 'h, carried by X chromosome. It is generally observed in males as a single gene for the defect is able to express itself as the Y chromosome is devoid of any corresponding allele (X^hY). Women will suffer from this disorder is rare as it occurs when a carrier woman (XX^h) marries with haemophilic man (X^hY). 50% girl babies will be carriers (XX^h) while the remaining 50% will be haemophilic (X^hX^h).

240. Refer to the given figure of antibody and answer the following questions.



(i) Identify a, b and c in the given diagram.

(ii) Write the chemical nature of an antibody.

(iii) Mention the type of immune response provided by an antibody.

(iv) Name the cells that produce antibodies in humans.

Ans :

(i) In the given structure of an antibody molecule, 'a' is the antigen binding site, 'b' is constant region of light chain and 'c' is constant region of heavy chain.

(ii) Antibodies are proteinous in nature.

(iii) Humoral immune response is an antibody mediated immune response.

(iv) B-lymphocytes produce antibodies in humans. These are an army of proteins which is produced in response to pathogens into our blood to fight with them.

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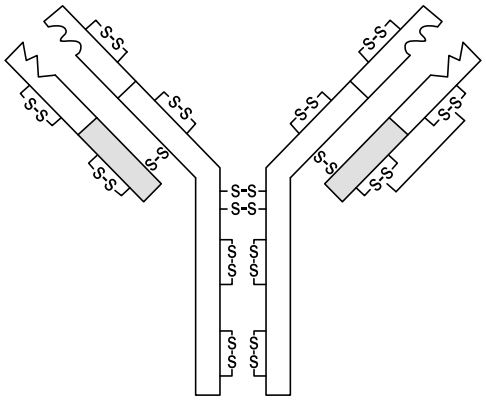
241. Acquired immunity is pathogen specific and characterised by memory. Whenever our body encounters a pathogen for the first time, it produces a response. Subsequent encounter with the same pathogen elicts a highly intensified secondary response.

(i) Name the two lymphocytes which are responsible for acquired immunity.

(ii) Identify the structure shown in the figure.



(iii) It is generally observed that the children who had suffered from chicken-pox in their childhood may not contract the same disease in their adulthood. Explain giving reasons the basis of such an immunity in an individual. Name this kind of immunity.

(iv) Differentiate between the two lymphocytes responsible for acquired immunity.

Ans :

(i) B lymphocytes and T lymphocytes are responsible for acquired immunity.

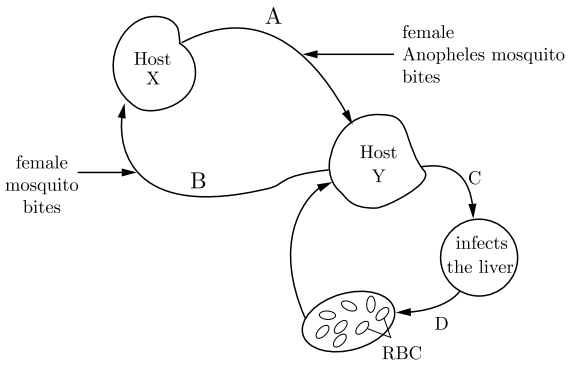
(ii) The structure shown in the figure is of antibody molecule.

(iii) Children who had suffered from chicken-pox may not contract the same disease in their adulthood because of development of memory cells. These type of cells develop during first encounter with the pathogen. Memory cells are highly specific and may remain in body for decades. Subsequent encounter with the same pathogen elicits a highly intensified secondary or anamnestic response. This type of immunity is known as acquired natural active immunity.

(iv) Differences between B-Lymphocytes (B-cells) and T-Lymphocytes (T-cells) are :

	B-Lymphocytes (B-cells)	**T-Lymphocytes (T-cells)**
(i)	B-cells form humoral or antibody mediated immune system	T-cells form cell-mediated immune system.
(ii)	They defend against viruses and bacteria that enter the blood and lymph.	They defend against pathogens including protists and fungi that enter the cells.
(iii)	Plasma cells formed by division of B-cells produce antibodies and provide immunity against foreign substances.	T lymphocytes produce different types of T-cells, killer T-cells react against cancer cells, suppressor cells inhibit immune system

242. The diagram shows the life cycle of a pathogenic protozoan.



(i) Name the parasitic stage that is being transferred from host 'X' to host 'Y'.

(ii) Write the changes the parasite undergoes in the liver.

(iii) Write the changes the parasite undergoes when it enters the RBC.

(iv) Trace the changes the parasite undergoes when the host 'X' takes its blood meal from infected host 'Y'.

(v) At which stage during the life cycle of the pathogen does the host 'Y' experience the symptoms of the disease ? Name the disease and the toxic substance responsible for these symptoms.

Ans : **DELHI 2023**

(i) Sporozoites.

(ii) Undergoes Asexual reproduction

(iii) The number increase asexually, parasites ultimately change into gametocytes/ undergoes gametogenesis

(iv) Fertilisation and development takes place in host 'X', ultimately forming the infective stage sporozoites.

(v) (a) Bursting of RBCs
(b) Malaria
(c) Haemozoin
(Award 1 mark if any two are correct)

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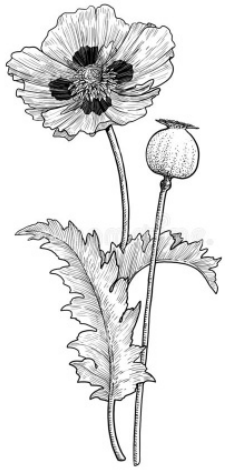
243. Carefully observe the given structure and answer questions that follow :



(i) Name the compound obtained from given plant.

(ii) What is the chemical nature of the compound obtained from this plant?

(iii) What are the major effects of the compound obtained from the given plant?

(iv) Write the chemical formula and draw the chemical structure of compound obtained from given plant.

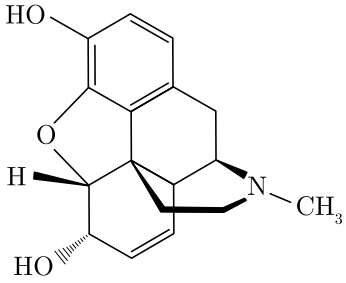
Ans :

(i) Morphine is obtained from the given plant, i.e., Papaver somniferum.

(ii) Morphine is the active principal alkaloid of opium. It is obtained from the latex of Papaver somniferum.

(iii) Morphine has strong analgesic effect as it can bind to specific receptors in central nervous system and relieves pain. It also depresses respiratory centre and contributes to the fall in blood pressure. It can cause bradycardia.

(iv) Chemical formula of morphine is $C_{17}H_{19}NO_3$.



244. Cancer is one of the most dreaded diseases that is a major cause of death across the globe. It is a non-communicalbe form of disease that cannot be transmitted from one person to another or can be said that these are not transmitted by pathogens. In cancerous cell, the property of contact inhibition is mainly lost. As a result of which they shows continuous growth and produces a tumour.

(i) How many types of tumour are there Which is more dangerous form ?

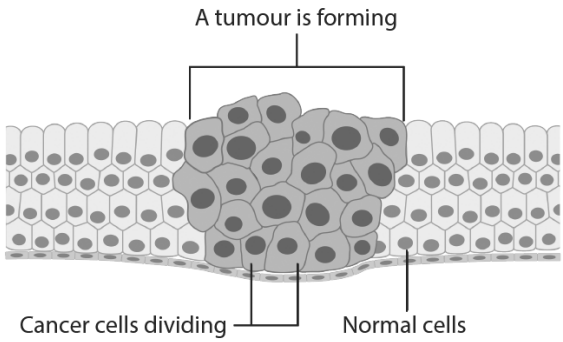
(ii) Draw a diagram showing a formation of a tumour.

(iii) List any two treatment of cancer.

Ans :

(i) litmours are of two main types i.e.
(a) Benign tumour
(b) Malignant tumour.
Out of these two the malignant tumour is more dangerous because it has property of spreading from one location to another with the flow of blood.

(ii)



(iii) (a) Surgery, (b) Radiotherapy

245. A person is showing physical features. This is due to a worm infection.

(i) Name the disease shown in the figure.

(ii) Name the causal organism from which this disease occurs.

(iii) List the other effects of the disease.

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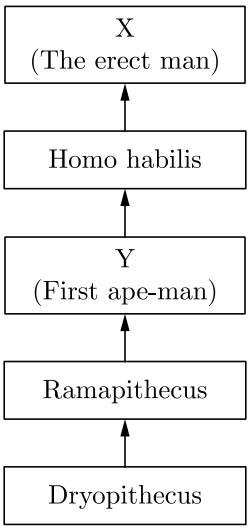
(1) It is a depressant and slows down body functions. It also induces drowsiness and lethargy.
(2) Other effects include indigestion, reduced vision, decreased weight, sterility and total loss of interest in work.

(iv) Drug 'X' (morphine) belongs to opioids. Opioids are the drugs, which bind to specific opioid receptors present in our central nervous system and gastrointestinal tract.

237. Human evolution is a lengthy evolutionary process within the history of primates. The stages given here show the order of evolutionary history of man.



(i) Identify 'X' and 'Y
(ii) What was the brain capacity of 'X'?
(iii) Give some important features of 'Y'.
(iv) When was 'X' discovered?

Ans :

(i) In the given representation of evolution of man, X and Y represent Homo erectus and A ustralopithecus, respectively.
(ii) Homo erectus (X) had a large brain around 900 cc.
(iii) Australopithecus (Y) was with bipedal locomotion, omnivorous diet and had erect posture. It had human-like teeth. Its brain capacity was about 500 cc.
(iv) Fossil of Homo erectus was discovered in Java in 1891.

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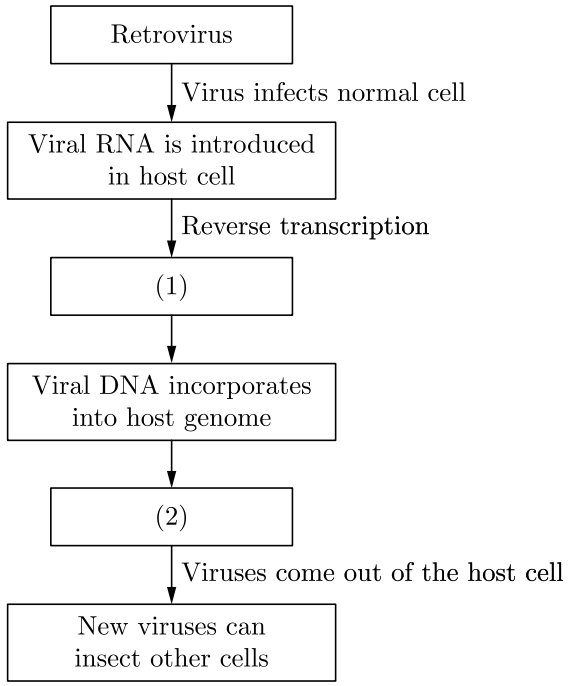
238. In the given flow chart, the replication of retrovirus in a host is shown. Observe and answer the following questions.



(i) What can be placed in blanks (1) and (2)?
(ii) Why is the virus called retrovirus? Give one example.
(iii) Can the infected cell survive while viruses are being replicated and released?
(iv) Name the disease which is caused by a retrovirus. How this virus gets transmitted?

Ans :

(i) (1) Viral DNA is produced by reverse transcriptase.
(2) New viral RNA is produced by the infected cell.
(ii) Retrovirus are called so because viral DNA is produced from viral RNA by reverse transcription, e.g., HIV.
(iii) Infected cell survives but T-lymphocytes decrease in number due to replication and release of virus.
(iv) AIDS is caused by the Human Immunodeficiency Virus (HIV) a retrovirus. Transmission of HIV infection generally occurs by (i) sexual contact with infected person, (ii) by transfusion of contaminated blood and blood products, (iii) by sharing infected needles and (iv) from infected mother to child during pregnancy.

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CHAPTER 8

MICROBES IN HUMAN WELFARE

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SUMMARY

1. MICROBES IN HOUSEHOLD FOOD PROCESSING

Several microbes are useful to human beings Lactobacillus, commonly called **LAB** (lactic acid bacteria) grow in milk. These convert **milk** into the **curd**. They produce acids which coagulate and digest the milk proteins. LAB produces vitamin B_{12}. LAB play role in fighting disease causing microbes.

2. DOUGH

It is used to make **dosa** and **idli**. It is fermented by bacteria. Dough is also used to make bread. It is fermented by baker's yeast or Saccharomyces cerevisieae.

3. MICROBES

Microbes are used to make **drinks** like (Toddy) and foods. They are used to ferment fish, soya-bean as well as the bamboo shoots for making foods.

4. BACTERIA AND FUNGI

Bacteria and **Fungi** are used to important specific texture, taste as well as the flavour in **cheese**.

5. SWISS CHEESE

Swiss cheese has large holes as CO_2 is produced in large amount by Propionibacterium sharmanii.

6. MICROBES IN INDUSTRIAL PRODUCTION

The microbes are used to produce **industrial products** like acetic acid, alcohol, citric acid, lactic acid etc. These are mostly used in industrial processes. In industries, the microbes are grown in big vessels called the **fermentors**.

7. FERMENTED BEVERAGES

Wine, Whisky, rum, brandy and beer etc. are beverages which are produced by using yeast.

The **brewer's yeast**, Saccharomyces cerevisieae is mostly used to **ferment** fruit juices and malted cereals. Various types of beverages are produced during the process. **Beer** is formed without **distillation**.

8. ANTIBIOTICS

These are chemical substances produced by certain microbes that can kill or retard the growth of pathogens. The **pathogen** are **diseases causing germs** or **microbes**. The antibiotics are produced by microbes.

9. PENICILLIN

The **Penicillin** is produced by the fungi named
(i) Penicillium notatum and
(ii) P. chrysogenum.
Other examples of antibiotics produced by microbes are Cephalosporin and tetracycline. Various dreadful diseases like whooping cough, diphtheria, leprosy, plague and others are treated by antibiotics.

10. CHEMICALS

Citric acid is produced by Aspergillus niger. Acetic acid is produced from Acetobacter aceti. Butyric acid is produced from Clostridium butylicum. Lactic acid is produced from Lactobacillus delbrueckii. The alcohol is produced from a yeast. So microbes are used in producing chemicals like organic acids.

11. ENZYMES

The enzymes are proteins are produced by several micobes. **Lipases** are used in **detergent formulations** to remove oily stains. **Peetinase** is used for **clarification** of the juices of fruits.

12. BIOACTIVE MOLECULES

These are produced by microbes. Streptokinase, cycosporina-A, statins, and lovaslatin are some biactive molecules.

Clostridium butylicum helps in the production of butyric acid. Candida lipolytica and Geotrichum candidum help in production of lipases that are added in detergents for removing oily stains from laundry.
Thus (b) is correct option.

22. Which one of the following fungi contains hallucinogens ?
(a) Morchella esculenta
(b) Amanita muscaria
(c) Neurospora sp.
(d) Ustilage sp.

Ans : **OD 2009**

Amanita muscaria is a member of class basidiomycetes. It is a poisonous mushroom and has hallucinogenic properties. It produces a toxic alkaloid, muscarine, which mimics the effects of acetylcholine and blinds to muscarinic receptors as well as ibotenic acid which also binds to different receptors. This leads to excitation of neurons bearing these receptors and hence hallucinations.
Thus (b) is correct option.

23. An alga which can be employed as food for human being is
(a) Ulothrix (b) Chlorella
(c) Spirogyra (d) Polysiphonia

Ans : **DELHI 2013**

Chlorella is a single celled chlorophycean alga with rich protein content. It is considered as a source of SCP (single cell protein) and also as food source during long space travels.
Thus (a) is correct option.

24. What gases are produced in anaerobic sludge digesters?
(a) Methane and CO_2 only
(b) Methane, Hydrogen sulphide and CO_2
(c) Methane, Hydrogen sulphide and O_2
(d) Hydrogen sulphide and CO_2

Ans : **FOREIGN 2011**

The type of gases produced by microbial activity depend upon the microbes and the organic substrates they utilise. Certain bacteria, called methanogens, grow anaerobically on cellulosic material and produce large amount of methane along with carbondioxide. These bacteria are commonly found in the anaerobic sludge during sewage treatment. Other anaerobic bacteria, involved in the process of anaerobic digestion produce other gases like ammonia and hydrogen sulphide.
Thus (b) is correct option.

25. Microbe used for biocontrol of pest butterfly caterpillars is
(a) Saccharomyces cerevisiae
(b) Bacillus thuringiensis
(c) Streptococcus sp.
(d) Trichoderma sp.

Ans : **FOREIGN 2016**

Biopesticides are those biological agents that are used for control of weeds, insects and pathogens. The microorganisms used as biopesticides are viruses, bacteria, protozoa, fungi and mites. Some of the biopesticides are being used at a commercial scale. Most important example is the soil bacterium, Bacillus thuringiensis (Bt). Spores of this bacterium produce the insecticidal cry protein. Therefore, spores of this bacterium kill larvae of insects which eat them.
Thus (b) is correct option.

26. A good producer of citric acid is
(a) Clostridium (b) Saccharomyces
(c) Aspergillus (d) pseudomonas

Ans : **SQP 2014**

Aspergillus niger produces citric acid, Clostridium butylicum produces butyric acid, Saccharomyces is used for commercial production of ethanol, Pseudomonas produces alkaline proteases.
Thus (c) is correct option.

27. Monascus purpureus is a yeast used commercially in the production of
(a) ethanmol
(b) streptokinase for removing clots from the blood vessels
(c) citric acid
(d) blood cholesterol lowering statins.

Ans : **COMP 2012**

Statins are produced by the yeast Monascus purpureus which have been commercialised as blood cholesterol lowering agents. It acts by competitively inhibiting the enzyme responsible for synthesis of cholesterol.
Thus (d) is correct option.

28. A patient brought to a hospital with myocardial infarction is normally immediately given
(a) penicillin (b) streptokinase
(c) cyclosporin-A (d) statins

Ans : **OD 2009**

Streptokinase (Tissue Plasminogen Activator or TPA) is an enzyme obtained from the culture of some haemolytic bacterium Streptococcus which is modified genetically to function as clot

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are not biodegradable. Thus, there is a recent trend to reduce the usage of these chemicals by supplementing them with green manures, biofertilizers, biological control methods and biopesticides which are natural occurring and do not cause harm to other forms of life including man.

29. GREEN MANURE

Green manure consists of quick-growing crop which is cultivated and ploughed under the soil to provide organic matter and addition nitrogen.

30. BIOFERTILIZERS

They are organisms which bring about nutrient enrichment of the soiul. These are also occurring in nature. Hence they are not poisonous. These include the nitrogen fixing organisms such as **Rhizhobium,** other **bacteria, cyanobacteria** and **fungi**. The bacteria may fix nitrogen in free-living form such as Azotobacter or in association with a legume or in loose association with some grasses (Azospirillium).

31. MYCORRHIZA

Mycorrhiza live in symbiotic association of fungi with the roots of higher plants. The Mycorrhiza are of two types :

(i) **ectomycorrhizae** or arbuscular mycorrhizae (AM) which grow freely on the surface of roots.

(ii) **endomycorrhizae** that grow inside the root.

Some **endomycorrhize** form vesicles and arbuscules and hence are called Vesicular arbuscular **mycorrhizae** (VAM). Genus **glomus** forms mycorrhizae.

32. BIOPESTICIDES

Pests can be reduced by biological control methods or by **biopesticides**.

33. BIOLOGICAL CONTROL OF WEEDS

Biological control of weeds is brought by using insects which would selectively feed on weeds only. The biopesticidal approach includes the following :

(i) Sterilization strategy.

(ii) Use of insect hormones,

(iii) Naturally occurring insecticides.

34. INTEGRATED PEST MANAGEMENT

Today, the need is integration of both the approaches i.e., integrated pest management (IPM) which envisages decrease and envisages decrease in artificial use of chemicals because they have proved to be very harmful to higher form of life including man. The pesticides and excessive use of fertilizers have altered the entire ecosystems. It is time that we thought carefully before using them.

35. BIOFERTILIZERS

Many Bio-fertilizers are available commercially in market for farmers's use.

OBJECTIVE QUESTIONS

1. Which of the following nematodes infect the roots of tobacco plants ?

(a) Bacillus thuringiensis (b) Cry IAC

(c) Meloidogyne incognita (d) Both 'A' and 'B'

Ans : **OD 2024, 2018**

A nematode called Meloidogyne incognita injects the roots of tobacco plant and causes a great reduction in field.

Thus (c) is correct option.

2. Which of the following is not a biofertilizer?

(a) Azotobacter

(b) Bacillus thuringiensis

(c) clostridium

(d) Azolla

Ans : **OD 2018**

Out of the given options, bacillus thurigniensis is not a biofertilizer. It is a Gram-positive, soil dwelling bacterium, commonly used as a biological pesticide.

Thus (b) is correct option.

3. Masses of bacteria associated with fungal filament to form a mesh like structure are called:

(a) Flocs (b) Methanogen

(c) Plasminogen (d) None of these

Ans : **OD 2024, 2018**

Flocs are masses with bacteria associated with fungal filaments to form mesh like structures. These microbes consume major part of organic matter in the effluent and help to reduce BOD of the effluent.

Thus (a) is correct option.

4. Biofertilizer is present in root nodules of which non-leguminous plant?

(a) Azotobacter (b) Clostridium

(c) Frankia (d) None

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Ans : **OD 2017**
Azotobacter is a free living nitrogen fixing bacteria.
Thus (a) is correct option.

5. Which Bacterium is used in formation of curd from milk?
(a) Clostridium (b) Lactobacillus
(c) Both a and b (d) streptococcus

Ans : **OD 2017, 2010**
The transformation of milk into curd is done by Lactobacillus bacteria. These bacteria. Convert lactose sugar present in milk into lactic acid.
Thus (b) is correct option.

6. Probiotics are:
(a) A new kind of food allergen
(b) Safe antibiotics
(c) Live microbial food supplement
(d) Cancer inducing microbes

Ans : **OD 2018**
Probiotics are living bacteria or other micro-organisms which are beneficial to health when consumed. They are beneficial for gastrointestinal infections, irritable bowel syndrome and inflammatory bowel disease.
Thus (c) is correct option.

7. Chlorella is a type of:
(a) bacteria (b) algae
(c) protozoa (d) single cell protein

Ans : **OD 2016**
Chlorella is a genus of single celled green algae belonging to the division chlorophyta. It is used for production of single cell protein.
Thus (b) is correct option.

8. Which of the following are single cell protein?
(a) Spirulina (b) Cholrella
(c) Scenadesmus (d) All of these

Ans : **OD 2016**
Single cell protein (SCP) is the dried cells of microorganisms, that has explored for being an alternative protein source as a food supplement to prevent protein deficiency. Members of genera chlorella, scenedesmus and spirulina are used for production of SCP.
Thus (a) is correct option.

9. The flour of Idli and Dosa is made by the use of which microbe?
(a) Bacteria (b) Lactobacillus
(c) Virus (d) Yeast

Ans : **OD 2015**
Flour of Idli and Dosa is made by using yeast. It acts a natural fermenter and make the flour light and fluffy.
Thus (d) is correct option.

10. Which one of the following is helpful in the improvement of soil?
(a) Insecticide (b) Biofertilizer
(c) Yeast (d) All of these

Ans : **OD 2015**
Out of the given options biofertilizer helps in the improvement of fertility of soil. They promote plant growth by increasing the supply or availability of primary nutrients to the host plants.
Thus (b) is correct option.

11. Pasteurization is heating of :
(a) milk only
(b) any liquid at 100°C
(c) any liquid above 70°C
(d) any liquid between 70° – 80°C followed by rapid cooling.

Ans : **OD 2013**
Pasteurization is the process of heating and then rapidly cooling, liquids (milk) or food in order to kill microbes that may expedite their spoilage or cause disease. The French scientist who invented the process of pasteurization was Louis Pasteur.
Thus (d) is correct option.

12. Biogas contains:
(a) CO_2 (b) H_2S
(c) CH_4 (d) All of these

Ans : **OD 2012**
Biogas typically refers to a mixture of different gases produced by the breakdown of organic matter in the absence of oxygen. Biogas is primarily methane (CH_4) and Carbon dioxide (CO_2) and may have small amounts of hydrogen sulphide (H_2S), moisture and siloxanes.
Thus (d) is correct option.

13. The bacteria found in the root nodules of leguminous plants are:
(a) Rhizobium (b) Azotobacter
(c) Staphylococcus (d) Lactobacillus

Ans : **OD 2012**
Rhizobium are bacteria that lives in symbiotic association with root nodules of leguminous plants. These bacteria convert atmospheric nitrogen into nitrogenous compounds which can be readily utilised by plants.
Thus (a) is correct option.

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14. Who among the following is not associated with microbiology?
(a) Louis Pasteur (b) J.D. Watson
(c) Stephan Hales (d) Robert Koch

Ans : OD 2010

James Dewey Watson or JD Watson is an American molecular biologist who discovered structure of DNA along with Francis crick and Rosalin Frankin
Stephen hales was an English botanist and physiologist. He was the first person to measure blood pressure.
Thus (c) is correct option.

15. Which of the following is an important source of biofertilizer?
(a) Green algae (b) yeast
(c) Bacteria (d) Red algae

Ans : OD 2012

Bacteria are important source of biofertilizers.
Thus (c) is correct option.

16. Conversion of milk of curd improves its nutritional value by increasing the amount of
(a) Vitamin D (b) Vitamin A
(c) Vitamin B_{12} (d) Vitamin E

Ans : DELHI 2005, COMP 2017

Lactobacillus bacteria convert milk into curd. It produces acids that coagulate and partially digest the milk proteins. A small amount of curd added to the fresh milk as inoculum or starter contains millions of lactobacillus which at suitable temperature multiply, thereby converting value by increasing Vitamin B_{12} content and a number of organic acids.
Thus (c) is correct option.

17. Select the mismatch
(a) Rhodospirillum – Mycorrhiza
(b) Anabaena – Nitrogen fixer
(c) Rhizobium – Alfalfa
(d) Frankia – Alnus

Ans : COMP 2020

Rhodospirillum is a free-living nitrogen fixing bacteria. Mycorrhiza is the symbiotic association between fungi and roots of higher plants. The most common fungal partners of mycorrhiza are Glomus species.
Thus (a) is correct option.

18. Which of the following in sewage treatment removes suspended solids?
(a) Secondary treatment
(b) Primary treatment
(c) Sludge treatment
(d) Tertiary treatment

Ans : OD 2019

Primary of physical treatment is the process of removal of small and large, floating and suspended solids from sewage through two processes of filtration and sedimentation.
Thus (b) is correct option.

19. The guts of cow and buffalo possess
(a) Methanogens (b) Cyanobacteria
(c) Fucus sp. (d) Chlorella sp.

Ans : COMP 2010

Methanogens like Methanobacterium are found in the rumen (a part of the stomach) of cattle. A lot of cellulosic material is also available in the rumen. In rumen. These bacteria help in the breakdown of cellulose and play an important role in nutrition of cattle.
Thus (a) is correct option.

20. Which of the following is correctly matched for the product produced by them?
(a) Methanobacterium : Lactic acid
(b) Penicillium notatum : Acetic acid
(c) Sacchromyces cerevisiae : Ethanol
(d) Acetobacter aceti : Antibiotics

Ans : DELHI 2018

Methanobacterium is useful in the production of biogas. Penicilluim notatum is used to produce penicillin, an antibiotic. Acetobacter aceti is used to obtain acetic acid.
Thus (c) is correct option.

21. Which of the following is wrongly matched in the given table?

	Microbe	**Product**	**Application**
(a)	Streptococcus	Streptokinase	Removal of clot from blood vessel
(b)	Clostridium butylicum	Lipase	Removal of oil stains
(c)	Trichoderma polysporum	Cyclosporin A	Immuno-suppressive drug
(d)	Monascus purpureus	Statins	Lowering of blood cholesterol

Ans : SQP 2015

	Microbe	**Product**	**Application**
(b)	Clostridium butylicum	Lipase	Removal of oil stains

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cyanobacteria. Rhizobium bacteria is found in the nodules on the roots of leguminous plants by symbiotic association. These bacteria fix atmospheric nitrogen into organic forms, which is used by the plants as nutrient. Fungi are also known to form symbiotic association with plants called mycorrhiza. Cyanobacteria are autotrophic microbes widely distributed in an aquatic and terrestrial environments. Many of which can fix atmospheric nitrogen, e.g., Anabaena, Nostoc, Oscillatoria etc. But Agrobacterium tumefaciens is a pathogen of several dicot plants. It causes gall tumour in the plants.
Thus (a) is correct option.

34. Which of the following is mainly produced by the activity of anaerobic bacteria on sewage?
(a) Laughing gas (b) Propane
(c) Mustard gas (d) Marsh gas

Ans : **FOREIGN 2008**

Marsh gas or methane gas is mainly produced by the activities of anaerobic bacteria on sewage. Sewage contains large amounts of organic matter and microbes, many of which are pathogenic. These microbes (bacteria and fungi) are digested during secondary treatment process of sewage by anaerobic bacteria. During digestion, bacteria produce a mixture of gases such as methane, hydrogen sulphide and carbon dioxide. These gases are called biogas and can be easily used as a source of energy as it is inflammable.
Thus (d) is correct option.

35. An organism used as a biofertilizer for raising soybean crop is
(a) Azotobacter (b) Azospirillum
(c) Rhizobium (d) Nostoc

Ans : **DELHI 2008**

Rhizobium is sued as a biofertilizer for raising crop. Rhizobium japonicum forms symbiotic association in the roots of the leguminous plant, soybean.
Thus (c) is correct option.

36. Ethanol is commercially produced through a particular species of
(a) Saccharomyces (b) Clostridium
(c) Trichoderma (d) Aspergillus

Ans : **SQP 2009**

Ethanol is commercially produced through a particular species of yeast Saccharomyces (Saccharomyces cerevisiae)
Thus (a) is correct option.

37. Organisms called methanogens are most abundant in a
(a) sulphur rock (b) cattle yard
(c) polluted stream (d) hot spring

Ans : **OD 2010**

Methanogens are any of various archaebacteria that produce methane; they include genera such as Methanobacillus and Methanothrix. Methanogens are obligate anaerobes found in oxygen- deficient environments, such as marshes, swamps, sludge and the digestive systems of ruminants. They are also utilised in gobar gas plants.
Thus (b) is correct option.

38. Consider the following statements (A-D) about organic farming.
A. Utilizes genetically modified crops like Bt cotton
B. Uses only naturally produced inputs like compost
C. Does not use pesticides and urea
D. Produces vegetables rich in vitamins and minerals
Which of the above statements are correct?
(a) B, C and D (b) C and D only
(c) B and C only (d) A and B only

Ans : **FOREIGN 2009**

Organic farming is the form of agriculture that relies on techniques such as crop rotation, green manure, compost and biological pest control to maintain soil productivity and control pest on a farm. Organic farming excludes or strictly limited the use of manufactured fertilizers, pesticides (which include herbicides, insecticides and fungicides), plant growth regulators such as hormones, food additives and genetically modified organisms.
Thus (c) is correct option.

39. Which one of the following is a wrong matching of a microbe and its industrial product, while the remaining three are correct?
(a) Yeast - statins
(b) Acetobacter aceti - acetic acid
(c) Clostridium butylicum - lactic acid
(d) Aspergillus niger - citric acid

Ans : **COMP 2010**

Microbes are used for commercial and industrial production of certain chemicals like organic acids, alcohols and enzymes. Examples of acid producers are Aspergillus niger (a fungus) of citric acid, Acetobacter aceti (a bacterium) of acetic acid:

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buster. Therefore, it helps in clearing blood clots inside the blood vessels through dissolution of intravascular fibrin during myocardial infarction.
Thus (b) is correct option.

29. A nitroge-fixing microbe associated with Azolla in rice fields is
(a) Spirulina (b) Anabaena
(c) Frankia (d) Tolypothrix

Ans : **DELHI 2008**

Azolla plays a very important role in rice production. Azolla and its nitrogen-fixing partner, Anabaena, have been used as green manure to fertilize rice paddies and increase production. With the help of Azolla, rice can be grown year after year, several crops a year, with little or no decline in productivity; hence no rotation of crops is necessary. So, Azolla is an excellent bio-fertlizer.
Thus (b) is correct option.

30. Which one of the following is an example of carrying out biological control of pests/diseases using microbes?
(a) Trichoderma sp. against certain plant pathogens.
(b) Nucleopolyhedrovirus against white rust in Brassica.
(c) Bt-cotton to increase cotton yield.
(d) Lady bird beetle against aphids in mustard.

Ans : **SQP 2006**

A biological control being developed for use in the treatment of plant disease in the fungus Trichoderma. Trichoderma species are free living fungi that are very common in the root ecosystems. They are effective biocontrol agents of several plant pathogens.
Thus (a) is correct option.

31. In gobar gas, the maximum amount is that of
(a) butane (b) methane
(c) propane (d) carbon dioxide.

Ans : **FOREIGN 2006**

Biogas or gobar gas is a methane rich fuel gas produced by anaerobic breakdown or digestion of biomass with the help of methanogenic bacteria. It is made up of methane (50-70 %), carbon dioxide (30-40 %) with traces of nitrogen, hydrogen sulphide and hydrogen.
Thus (b) is correct option.

32. The domestic sewage in large cities
(a) has a high BOD as it contains both aerobic and anaerobic bacteria
(b) is processed by aerobic and then anaerobic bacteria in the secondary treatment in Sewage Treatment Plants (STPs)
(c) when treated is STPs does not really require the aeration step as the sewage contains adequate oxygen.
(d) has very high amount of suspended solids and dissolved salts.

Ans : **COMP 2008**

Sewage water can be purified by passing it through sewage treatment plants with the action of heterophic microorganisms. There are three stages of this treatment - primary, secondary and tertiary. Primary treatment removes floating and suspended solids from sewage through two processes of filtration and sedimentation. First floating matter is removed through sequential filtration. The filtrate is kept in large open settling tanks where grit settles down. The sediment is called primary sludge while the supernatant is called effluent . primary sludge traps a lot of microbes and debris. In secondary treatment, the primary effluent is taken to aeration tanks. A large number of aerobic heterotrophic microbes grow in the aeration tank. They form flocs. Flocs are masses of bacteris held together by slime and fungal filaments to form mesh like structures. The microbes digest a lot of organic matter, converting it into microbial biomass and releasing a lot of minerals. As the BOD of the waste matter is reduced to 10-15% of raw sewage, it passed into settling tank. Thus secondary treatment is more or less biological. The sediment of settling tank is called activated sludge. The remaining is passed into a large tank called anaerobic sludge digester. It is designed for continuous operation. The aerobic microbes present in the sludge get killed Anaerobic microbes present in the sludge get killed. Anaerobic microbes digest the organic mass as well as aerobic microbes digest the organic mass as well as aerobic microbes of the sludge. They are of two types, nonmethanogenic and methanogenic. Methanogenic bacteria produce a mixture of gases containing methane, H_2S and CO_2.
Thus (b) is correct option.

33. Which one of the following is not a biofertilizer?
(a) Agrobacterium (b) Rhizobium
(c) Nostoc (d) Mycorrhiza

Ans : **OD 2006**

Biofertilizers are organisms that enrich the nutrient quality of the soil. The main sources of biofertilizers are bacteria, fungi and

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13. MICROBES IN SEWAGE TREATMENT

This municipal water is **sewage**. Before disposal the **sewage** must be treated to make it less polluting in STP's (sewage treatment plants). It is done by microbes which an **heterotrophic** and found in sewage.

14. SEWAGE TREATMENT

The microbes are used to treat sewage by **activated sludge formation**. It helps in **recycling of water** in nature. The main steps are **primary treatment, secondary treatment**.

15. PRIMARY TREATMENT OF SEWAGE

Large sized objects are removed in it like polythene bags. The sewage is passed through a **bar screen** having **steel bars** (2-8 cm aparts). Then sewage is passed into the grit chamber for sedimentation. It is then sent to next stage of treatment.

16. SECONDARY TREATMENT OF SEWAGE

Primary effluent is now passed in big aeration tanks. Here it is agitated by mechanical means and air is pumped into this Floes (aerobic microbes) develop in it. They reduces the BOD of effluent. The effluent is passed into settling tanks and bacterial flocks are permitted to sediment called the activated sludge. It is pumped into anaerobic sludge digesters. The bacteria produces gases like CH_4, H_2S, CO_2, etc. This water is passed into rivers and lakes.

17. GANGA ACTION PLAN AND YAMUNA ACTION PLAN

Untreated sewage is dumped into major rivers like **Yamuna** and **Ganga**. It pollutes the drinking water and causes many **Water borne diseases**. Yamuna action plan and Ganga Action plans are initiated by **Ministry of Environment and Forests** in our country. Only treated sewage can be put into these rivers.

18. ENERGY GENERATION

Biogas contains a mixture of gases mainly CH_4. It is produced by microbial activity. In fermentation of dough, cheese making and beverages, CO_2. It is produced by microbial activity. In fermentation of dough, cheese, cheese making and beverages, CO_2, H_2 are produced. Methanobacterium is a **methanogen** bacterium found mostly in anaerobic sludge of sewage.

In rumen of cattle bacteria reside to breakdown **cellulose**. Cow dung or gobar is rich in such bacteria.

19. BIOGAS PLANT

It is made of concrete tank (10 to 15 feet deep). Slurry is fed into it. A floating cover lies above it. Has plant has an **outlet** connected to pipe in house for gas. The used **slurry** in it becomes **fertilizer**.

20. MICROBES AS BIOCONTROL AGENTS

Biological methods of control are used for controlling plant diseases, pest and pollutants. It minimizes the use of chemicals and pesticides that pollute environmental, fruits, vegetables and crop plants also. They are **toxic** to us. **Bacterial spores** act as **biopesticides**.

21. THE BIOCONTROL AGENTS

The Biocontrol agents are Trichoderma, Bacillus and Baculoviruses. B. thuringiensis is used to kill insects larvae by a toxin.

22. WEED KILLERS

The chemicals used for destroying weeds, pests and insects are called **weed killers**, **pesticides** and **insecticides** respectively.

23. PEST RESISTANT VARIETIES

The use of **disease** and **pest resistant varieties** is the ideal solution. But cotton is such example.

24. INTEGRATED PEST MANAGEMENT

Integrated Pest Management is a good alternative to pesticides.

25. ORGANIC FARMING

Organic farming has proved as a boon for both to the farmers and the environment.

26. MANURES AND FERTILIZERS

NODIA

To increase the agricultural production it is necessary to provide sufficient **manures** and **fertilizers** to the fields. **Fertilizers** are chemically or synthetically prepared chemicals which provide the necessary elements to the soil which plants require for their growth and development.

27. PESTICIDES

To agriculturists, agricultural produce has been under the attack of many **pests** which used to eat away it. To kill the pests, certain poisonous chemicals are used. These are termed as **pesticides**.

28. FERTILIZERS AND PESTICIDES

Fertilizers and **Pesticides** have posed hazard to all organisms including man because they

Clostridium butylicum (a bacterium) of butyric acid and Lactobacillus (a bacterium) of lactic acid.
Thus (a) is correct option.

40. Select the correct statement form the following.
(a) Biogas is produced by the activity of aerobic bacteria on animal waste.
(b) Methanobacterium is an aerobic bacterium found in rumen of cattle
(c) Biogas, commonly called gobar gas, is pure methane
(d) Activated sludge-sediment in settlement tanks of sewage treatment plant is a rich source of aerobic bacteria.

Ans : **DELHI 2019**

Sewage water can be purified by passing it through sewage treatment plants with the action of heterophic microorganisms. There are three stages of this treatment - primary, secondary and tertiary. Primary treatment removes floating and suspended solids from sewage through two processes of filtration and sedimentation. First floating matter is removed through sequential filtration. The filtrate is kept in large open settling tanks where grit settles down. The sediment is called primary sludge while the supernatant is called effluent primary sludge traps a lot of microbes and debris. In secondary treatment, the primary effluent is taken to aeration tanks. A large number of aerobic heterotrophic microbes grow in the aeration tank. They form flocs. Flocs are masses of bacteris held together by slime and fungal filaments to form mesh like structures. The microbes digest a lot of organic matter, converting it into microbial biomass and releasing a lot of minerals. As the BOD of the waste matter is reduced to 10-15% of rew sewage, it passed into settling tank. Thus secondary treatment is more or less biological. The sedimant of settling tank is called activated sludge. The remaind is passed into a large tank called anaerobic sludge digester. It is designed for continuous operation. The aerobic microbes present in the sludge get killed Anaerobic microbes present in the sludge get killed. Anaerobic microbes digest the organic mass as well as aerobic microbes digest the organic mass as well as aerobic microbes of the sludge. They are of two types, nonmethanogenic and methanogenic. Methanogenic bacteria produce a mixture of gases containing methane, H_2S and CO_2.
Thus (d) is correct option.

41. A common biocontrol agent for the control of plant diseases is
(a) baculovirus
(b) Bacillus thuringiensis
(c) Glomus
(d) Trichoderma

Ans : **OD 2020**

The natural method of pest and pathogen control involving use of viruses, bacteria and other insects (which are their natural predators and pests) is called biocontrol or biological control. For example, free living fungus Trichoderma exerts biocontrol over several plant pathogens for the control of plant diseases. Baculoviruses (mostly of genus Nucleopolyhedrovirus) are also used as biocontrol agents but they are used for the control of insects and arthropods. Bacillus thuringiensis is a soil bacterium which is used as biopesticide. Glomus species are the most common fungal partners of mycorrhiza residing in the roots of higher plants.
Thus (d) is correct option.

42. The common nitrygen-fixer in paddy fields is
(a) Rhizobium (b) Azospirillum
(c) Oscillatoria (d) Frankia

Ans : **SQP 2018**

Azospirillum is an anaerobic nitrogen fixing bacteria which forms loose association with roots of some plants. Inoculation of paddy fields with these bacteria helps in increasing yield and saving of nitrogen fertilizers.
Thus (b) is correct option.

43. Which one of the following is not used inorganic farming?
(a) Glomus (b) Earthworm
(c) Oscillatoria (d) Snail

Ans : **FOREIGN 2017**

Organic farming is a method of farming system which primarily aimed to keep the soil alive and in good health by use of organic wastes and other biological material along with beneficial microbes (biofertilizers) to release nutrients to crops for increased sustainable production in an ecofriendly, pollution free environment.

Basic components of organic farming are green manures, farm yard manure, vermicompost, crop rotation, biopesticides and biofertilizers. Glomus being a mycorrhizal component, earthworm being a vermicompost and oscillatoria being a nitrogen fixing blue green algae can be used in organic farming. Snail cannot be a component of organic farming.
Thus (d) is correct option.

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44. Which one of the following pairs is wrongly matched?
(a) Alcohol - Nitrogen
(b) Fruit juice - Pectinase
(c) Textile - Amylase
(d) Detergents - Lipase

Ans : SQP 2017

The natural method of pest and pathogen control involving use of viruses, bacteria and other insects (which are their natural predators and pests) is called biocontrol or biological control. For example, free living fungus Trichoderma exerts biocontrol over several plant pathogens for the control of plant diseases. Baculoviruses (mostly of genus Nucleopolyhedrovirus) are also used as biocontrol agents but they are used for the control of insects and arthropods. Bacillus thuringiensis is a soil bacterium which is used as biopesticide. Glomus species are the most common fungal partners of mycorrhiza residing in the roots of higher plants.
Thus (a) is correct option.

45. An example of endomycorrhiza is
(a) Nostoc (b) Glomus
(c) Agaricus (d) Rhizobium

Ans : COMP 2016

The genes Glomus form endomycorrhiza, a symbiotic associations with plants. The fungal symbiont in these associations absorbs phosphorus from soil and passes it to the plant. Plants having such associations show other benefits also, such as resistance to root-borne pathogens, tolerance to salinity and drought, and an overall increase in plant growth and development.
Nostoc is a blue green algael, Agaricus is a basidiomycetes, Rhizobium is a eubacteria.
Thus (b) is correct option.

46. Trichoderma harzianum has proved a useful microorganism for
(a) gene transfer in higher plants
(b) biological control of soil-borne plant
(c) bioremediation of contaminated soils
(d) reclamation of wastelands.

Ans : OD 2015

The natural method of pest and pathogen control involving use of viruses, bacteria and other insects (which are their natural predators and pests) is called biocontrol or biological control. For example, free living fungus Trichoderma exerts biocontrol over several plant pathogens forthe control of plant diseases. Baculoviruses (mostly of genus Nucleopolyhedrovirus) are also used as biocontrol agents but they are used for the control of insects and arthropods. Bacillus thuringiensis is a soil bacterium which is used as biopesticide. Glomus species are the most common fungal partners of mycorrhiza residing in the roots of higher plants.
Thus (b) is correct option.

47. Nitrogen fixation in root nodules of Alnus is brought about by
(a) Frankia (b) Azorhizobium
(c) Bradyhizobium (d) Clostridium

Ans : DELHI 2016

The most common symbiotic association of legume and bacteria on roots is as nodules, which are small outgrowth on the roots. The microbe Frankia is symbiont in root nodules of several non-legume plants like Casurina and Alnus. Both Rhizobium and Frankia are free living in soil but as symbiont can fix atmospheric nitrogen.
Thus (a) is correct option.

NODIA

48. Which one of the following proved effective for biological control of nematodal diseases in plants?
(a) Gliocladium virens
(b) Paecilomyces lilacinus
(c) Pisolithus tinctorius
(d) Pseudomonas cepacia

Ans : FOREIGN 2015

Paecilomyces lilacinus proved effective for biological control of nematodal diseases in plant.
Thus (b) is correct option.

49. Probiotics are
(a) cancer inducing microbes
(b) new kind of food allergens
(c) live microbial food supplement
(d) safe antibiotics.

Ans : COMP 2016

Probiotics are dietary supplements containing potentially beneficial bacteria or yeast, with lactic acid bacteria (LAB) as the most common microbes used. LAB have been used in the food industry for many years, because they are able to convert sugars (including lactose) and other carbohydrates into lactic acid. They not only provides the characteristic sour taste of fermented dairy foods such as yogurt, but acts as a preservative, by lowering the pH and creating fewer opportunities for spoilage organisms to grow.
Thus (c) is correct option.

50. The most thoroughly studied of the known bacteria- plant interactions is the
(a) cyanobacterial symbiosis with some aquatic ferns
(b) gall formation on certain angiosperms by Agrovacterium
(c) nodulaton of Sesbania stems by nitrogen fixing bacteria
(d) plant growth stimulation by phosphate-solubilising bacteria.

Ans : **DELHI 2017**

Abrobacterium tumefaciens is the causative agent of crown gall, an important disease of many commercial crops. This disease has come to be recognized in recent years as being caused by a DNA plasmid (Ti plasmid) carried by bacterium and transferred to the plant cells.
Thus (b) is correct option.

51. Which one of the following pairs is wrongly matched?
(a) Yeast - Ethanol
(b) Streptomycetes - Antibiotic
(c) Coliforms - Vinegar
(d) Methanogens - Govar gas

Ans : **OD 2018**

Coliform bacteria are a commonly used bacterial indicator of sanitary quality of foods and water. It is not involved in the production of vinegar.
Thus (c) is correct option.

52. Which one of the following pairs is not correctly matched?

(a)	Streptomyces	-	Antibiotic
(b)	Serratia	-	Drug addiction
(c)	Spirulina	-	Single cell protein
(d)	Rhizobium	-	Biofertilizer

Ans : **COMP 2011**

Serratia marcescens is considered a harmful human pathogen which has been known to cause urinary tract infections, wound infections and pneumonia. Serratia bacteria also have many antibiotic resistance properties which may become important if the incidence of Serratia infections dramatically increases.
Thus (b) is correct option.

53. During anaerobic digestion of organic waste, such as in producing biogas, which one of the following is left undegraded?
(a) Lipids (b) Lignin
(c) Hemi-cellulose (d) Cellulose

Ans : **SQP 2015**

Lignin is a complex polymer of phenylpropane units, which are cross-linked to each other with a variety of different chemical bonds. This complexity has thus far proven as resistant to microbial degradation.
Thus (b) is correct option.

54. During the formation of bread it becomes porous due to release of CO_2 by the action of
(a) yeast (b) bacteria
(c) virus (d) protozoans

Ans : **OD 2016**

Saccharomyces converts starch on sugars to pyruvc acid through EMP patheay. Then this pyruvic acid is converted to acetaldehyde and finally to ethyl alcohol in the absence of oxygen. This entire process is called fermentation.
$C_6H_{12}O_6 \rightarrow 2CH_2COCOOH \rightarrow 2C_2H_5OH + 2CO_2$
This released carbon dioxide makes the dough to rise and gives spongy nature to bread.
Thus (a) is correct option.

55. Spoilage of oil can be detected by which fatty acid
(a) oleic acid (b) lonolenic acid
(c) linoleic acid (d) erucic acid

Ans : **FOREIGN 2013**

Erucic acid is a unsaturated fatty acid belonging to the oleic acid series, occurring as glycerides in rape seed oil and other vegetable oils. It is the cis-isomer, the trans-isomer being brassidic acid. Erucic acid is used as abinder for oil paints. It is useful in amnufacture of emulsions to coat photographic films and papers. Oleic acid is found in various animal and vegetable sources. It is widely used in industries including textile, chemical, medicine, leather, stationery, paper making, etc. Linolenic acids is used in making soaps, emulsifiers and quick-drying oils, in beauty products. It helps in acne reduction, moisture retention, etc. Linoleic acid is an important fatty acid especially for growth and development of infacts. Commercially it is used in margarine, animal feeds, soaps and drugs.
Thus (d) is correct option.

56. Which aquatic fern is used to increase the yield in paddy crop?
(a) Azolla (b) Salvinia
(c) Marsilea (d) Isoetes

Ans : **SQP 2014**

Azolla plays a very important rolein rice production. Azolla and its nitrogen-fixing partner, Anabaena, have been used as green manure to

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insecticide used by man is azadirachtin obtained from Azadirachta indica.
Rotenone is another natural insecticide which is obtained from the roots of Derris and Lochocarpers. It is harmless to warm blooded animals.
Thus (b) is correct option.

70. The organism, used for alcohol fermentation, is
(a) Aspergillus (b) Saccharomyces
(c) Pseudomonas (d) Penicillium

Ans : **OD 2012**

Saccharomyces converts starch on sugars to pyruvic acid through EMP pathway. Then this pyruvic acid is converted to acetaldehyde and finally to ethyl alcohol in the absence of oxygen. This entire process is called fermentation.
$C_6H_{12}O_6 \rightarrow 2CH_2COCOOH \rightarrow 2C_2H_5OH + 2CO_2$
This released carbon dioxide makes the dough to rise and gives spongy nature to bread.
Thus (b) is correct option.

71. One of the major difficulties in the biological control of insect pest is that
(a) the method is less effective as compared with the use of insecticides.
(b) the practical difficulty of introducing the predator to specific areas
(c) the predator develops a preference to other diets and may itself become a pest
(d) the predator does not always survive when transferred to an new environment.

Ans : **FOREIGN 2006**

Insect enemies play important role in nature for managing the phytophagous insect pests and keep a balance. It is just possible that predators of a particular plant pest are unable to get established and multiple in a particular environment. In such cases, the predators are reared in the laboratory and let off at a particular time when the pests are about to threaten the crops. And then this practice become expensive.
Thus (d) is correct option.

72. Biological control of agricultural pests, unlike chemical control, is
(a) self perpetuating (b) polluting
(c) very expensive (d) toxic

Ans : **DELHI 2013**

The control of insect pests by the introduction, encouragement and artificial increase of biological agencies like predaceous and parasitic insects, other animals and diseases is termed as biological control. It is basically a natural in which man plays significant role of making the biological agencies more effective. Of these agencies, insect enemies play important role in nature for managing the phytophagous insect pests and keep a balance e.g., lady bugs or praying mantis, frog, toads, lizard and birds are employed by man to eat up the insect pests like aphids. It is a self perpetuating method.
Thus (a) is correct option.

73. Which of the following species does not have the ability to fix atmospheric nitrogen?
(a) Azotobactor (b) Anabaena
(c) Nostoc (d) Spirogyra

Ans : **SQP 2014**

Members of kingdom Monera- bacteria and cyanobacteria (blue green algae) have the ability of fix nitrogen. Azotobacter is a N_2-fixing bacteria. Anabaena and Nostoc are heterocystous blue-green algae. The heterocysts are the sites of N_2 -fixation. Spirogyra is one of the commonest green algae. It has no function in nitrogen fixation.
Thus (d) is correct option.

74. Which one of the following statements is correct?
(a) Legumes fix nitrogen only through the specialized bacteria that live in their roots.
(b) Legumes fix nitrogen independently of the specialized bacteria that live in their roots.
(c) Legumes fix nitrogen only through specialized bacteria that live in their leaves.
(d) Legumes are incapable of fixing nitrogen.

Ans : **DLEHI 2013**

The nitrogen-fixing ability of leguminous plants is not a property of the plants as such but results from infection of their roots by bacteria in the soil, infection leading the formation of nodules. These organisms are Gram-negative motile rods that are classified in the genus Rhizobium.
Thus (a) is correct option.

NODIA

ASSERTION AND REASON

DIRECTION : Each of these questions contains as Assertion following by Reason. Read them carefully and answer the question on the basis of following options. You have to select the one that best describes the two statements.

75. **Assertion :** Leguminous plants are nitrogen fixers.
Reason : Leguminous plants have Rhizobium in their root nodules.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

Ans : **FOREIGN 2010**

Pheromones are volatile chemicals produced by a given species to communicate with other individuals of the same species to change their behaviour. The synthetic versions of lepidopteran pheromones can be used as pesticides. Sometimes the relative amount of several pheromone chemicals in a pesticide product determine which specific pests are controlled when the pesticide product releases pheromone into the air where males are looking for females, the males become confused and cannot easily locate the females. As a result, many of the females do not mate and lay eggs and there are many fewer offspring than usual. These insect pheromones are third generation pesticides. Other third generation pesticides are insect growth regulators, chitin synthesis inhibitors and juvenile hormons.
Thus (d) is correct option.

64. The biofertilizers are
(a) Anabaena and Azolla
(b) cow dung, manure and farmyard waste
(c) quick growing crop ploughed under soil
(d) none of these

Ans : **DELHI 2014**

Biofertilizers are organisms which bring about nutrient enrichment of the soil. Azotobacter is a free living, aerobic, nitrogen fixing bacteria. Anabena is a nitrogen fixing cyanobacteria that occurs in both free living and symbiotic associations with Azolla, Cycas roots, etc. Rhizobium lives symbiotically in root nodules of legumas and non-legumes. Vesicular-arbuscular mycorrhiza (VAM) is an example of endomycorrhiza in which fungal hypase penetrate the cortical cells of grasses to form vesicles.
Thus (a) is correct option.

65. Gobar gas contains mainly
(a) $CO_2 + H_2$ (b) $CO_2 + H_2O$
(c) CH_4 only (d) $CH_4 + CO_2$

Ans : **COMP 2008**

Biogas or gobar gas is a methane rich fuel gas produced by anaerobic breakdown or digestion of biomass with the help of methanogenic bacteria. It is made up of methane (50-70 %), carbon dioxide (30-40 %) with traces of nitrogen, hydrogen sulphide and hydrogen.
Thus (d) is correct option.

66. Cochineal insects have proved very useful for
(a) Cactus prevention
(b) Eichhornia prevention
(c) weeds control
(d) parthenium control

Ans : **OD 2016**

Extensive growth of Opuntia (Cactus) in Australia was checked through introduction of its natural herbivore, cochineal insect (Cactoblastis cactorum).
Thus (a) is correct option.

67. When a natural predator (living being) is applied on the other pathogen organism to control them, this process is called
(a) artificial control
(b) confusion technique
(c) biological control
(d) genetic engineering

Ans : **OD 2015**

The control of insect pests by the introduction, encouragement and artificial increase of biological agencies like predaceous and parasitic insects, other animals and diseases is termed as biological control. It is basically a natural in which man plays significant role of making the biological agencies more effective. Of these agencies, insect enemies play important role in nature for managing the phytophagous insect pests and keep a balance e.g., lady bugs or praying mantis, frog, toads, lizard and birds are employed by man to eat up the insect pests like aphids. It is a self perpetuating method.
Thus (c) is correct option.

NODIA

68. The citric acid is produced by
(a) Candida utilis
(b) Azotobacter suboxydans
(c) Aspergillus niger
(d) Streptococcus lactis

Ans : **SQP 2012**

Citric acid is obtained through the fermentation carried out by Aspergillus niger on sugary syrups. Citric acid is employed in dyeing, engraving, medicines, inks, flavouring and preservation of food and candies.
Thus (c) is correct option.

69. The rotenone is
(a) a natural herbicide
(b) a natural insecticide
(c) an insect hormone
(d) a bioherbicide

Ans : **COMP 2011**

Natural insecticides are those which are obtained from microorganisms and plants. The first natural

(iii) Bhals is prepared from wheat flour by the fermentation with Lactobacillus or Saccharomyces cerevisiae.

106. In which way have microbes played a major role in controlling diseases caused by harmful bacteria?

Ans : **OD 2010**

Microbes play an important role in controlling disease caused by harmful bacteria by the secretion of antibiotics. Antibiotics are the organic secretions, product of secondary metabolites, biologically active against a large number of organisms even in extremely low concentration e.g., Penicillin an antibiotic is produced by a fungus Penicillium chrysogenum is effective against the bacteria Staphylococci and Streptococci.

107. Name any two species of fungus, which are used in the production of antibiotics.

Ans : **FOREIGN 2008**

(i) Penicillium notatum and Penicillium chrysogenum. (Penicillin)

(ii) Aspergillus fumigatus (Fumagallin)

(iii) Cephalosporium acremonium (marine fungus) (Cephalosporin).

108. What is sewage ? In which way sewage can be harmful to us?

Ans : **SQP 2011**

The municipal waste-water which is generated everyday in large quantities in cities and towns is called Sewage. It contains human excreta, waste wash water containing detergents, waste water from kitchen, bathroom, industrial and agricultural wastes. It contains both organic and inorganic matter.

It is very harmful to us become of the presence of various harmful microorganisms which are highly pathogenic. Sewage has high BOD value and develop anaerobic conditions which (i) emit foul smell due to the anaerobic breakdown of organic matter in the sewage, (ii) oxygen deficiency in the sewage cause the death of many aquantic animals, (iii) It results in the dissemination of many water-borne diseases caused by microorganisms.

109. What is the key difference between primary and secondary sewage treatment?

Ans : **FOREIGN 2015**

Primary treatment is the mechanical screening and removal of solid, insoluble particulate materials by passing through filters and then through grit chamber where coarse solid material settle down by gravity.

Secondary treatment is a purely biological treatment involving microbial activity. The effluent is passed into large aeration tanks and agitated mechanically where aerobic microbes consume a major part of dissolved organic matter. Then the effluent is filtered and then chlorinated to kill any pathogen. The secondary effluent carries a considerable load of nitrates, phosphates and other minerals.

110. Do you think microbes can also be used as source of energy? If yes, how?

Ans : **OD 2020**

Yes, the activated sludge produced after secondary treatment of sewage is collected in an anaerobic digestive tanks where anaerobic microorganisms digest the organic matter and the gaseous product. Biogas (a mixture of CH_4, CO_2 and H_2S) is formed. It is highly inflammable and can be used as fuel, a source of energy.

Biogas is commercially produced inside the biogas plant which is mainly build in rural areas. Cattle dungs, human excreta and agricultural wastes are raw materials for biogas production.

111. Microbes can be used to decrease the use of chemical fertilizers and pesticides. Explain how this can be accomplished?

Ans : **DELHI 2016**

Now a days, microbes are used to decrease the use of chemical fertilizers and pesticides. These are used as biofertilizers and biopesticides. They are cheap, non-persistent, noe-toxic to other living organisms, biodegradable and non-pollutant ad harmless. Biopesticides are highly successful in controlling weeds, insects and pests.

A bacterial species Bacillus thuringiensis is known to kill a wide range of insects plant parasitic nemtodes, snails, protozoans and even cockroaches due to some insecticidal crystal proteins one of them thurioside. Scientists have now identified the genes for insecticidal crystal proteins. By recombinant DNA technology they have transferred the genes into several field crops such a cotton, Rice, Soyabean, Tomato etc. These genetically modified crop light against various insect pests e.g., Bt-cotton. These genetically modified crops are called Transgenic crops. Bt-cotton contains genes from Bacillus thuringiensis, which encodes for the cry proteins which possess insecticidal activity against many types of insects.

112. Three water samples namely river water, untreated sewage water and secondary effluent discharged from a sewage treatment plant were subjected to BOD test. The samples were labelled A, B and C; but the laboratory attendant did not

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(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **FOREIGN 2016**
The Rhizobium bacteria converts the atmospheric nitrogen into soluble nitrates that is absorbed by the plants.
Soybean root nodules, contain billions of Bradyrhizobium bacteria.
Thus (a) is correct option.

76. **Assertion :** Nitrogen-fixing enzyme in legume root nodules function at low oxygen concentration.
Reason : Low oxygen concentration is provided by leghaemoglobin.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **SQP 2006**
Leghaemoglobin is the oxygen scavenger and it protects nitrogen fixing enzyme nitrogenase from oxygen.
Thus (a) is correct option.

77. **Assertion :** Lichen is important for chemical industries.
Reason : Litmus and Orcein are formed from lichens.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **COMP 2015**
Litmus is an important and widely used dye in chemical laboratories as an acid-base indicator. It is obtained from Rocella montaigne. Orcein, a biological stain, is obtained from Rocella tinctoria.
Thus (a) is correct option.

78. **Assertion :** Yeasts such as Saccharomyces cerevisiae are used in baking industry.
Reason : Carbon dioxide produced during fermentation causes bread dough to rise by thermal expansion.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **OD 2018**
Yeast is a fermentation agent. It is a known fact that yeast raises bread dough to rise and hence, Yeast is also used to increase the volume, making the dough porous and the produce soft. It is the yeast that helps the dough to rise.
Thus (a) is correct option.

79. **Assertion :** Vitamins B_2 is found in cereals, green vegetables, brewer's yeast, egg white, milk and liver.
Reason : It can be commercially produced by some yeasts.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **OD 2009**
Besides cereals, green vegetables, brewer's yeast, egg white, vitamin B_2 is also produced by intestinal bacteria. The vitamin was first obtained in 1938 using wild strain of mould Ashbhya gossypii. Vitamin B_2 is essential for normal growth and reproduction in a number of laboratory animals.
Thus (b) is correct option.

VERY SHORT ANSWER QUESTIONS

80. Why are the fruit juices bought from market clearer as compared to those made at home?

Ans : **OD 2019**
The fruit juices made at home are turbid due to the presence of fibres, pectins and proteins while the enzymes pectinases and proteases are used to clarify fruit juices before marketing.

81. Name the gas released and the process responsible for puffing up of the bread dough when Saccharomyces cerevisiae is added to it.

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fertilize rice paddies and increase production. With the help of Azolla, rice can be grown year after year, several crops a year, with little or no decline in productivity; hence no rotation of crops is necessary. So, Azolla is an excellent biofertlizer. Thus (a) is correct option.

57. Which of the following is used to manufacture ethanol from starch?
(a) Penicillin (b) Saccharomyces
(c) Azotobactor (d) Lactobacillus

Ans : **DELHI 2011**

Saccharomyces converts starch on sugars to pyruvic acid through EMP patheay. Then this pyruvic acid is converted to acetaldehyde and finally to ethyl alcohol in the absense of oxygen. This entire process is called fermentation.
$C_6H_{12}O_6 \rightarrow 2CH_2COCOOH \rightarrow 2C_2H_5OH + 2CO_2$
This released carbon dioxide makes the dough to rise and gives spongy nature to bread.
Thus (b) is correct option.

58. Which or the following fern is an excellent biofertilizer?
(a) Marsilia (b) Pteridium
(c) Azolla (d) Salvinia

Ans : **SQP 2017**

Azolla plays a very important role in rice production. Azolla and its nitrogen-fixing partner, Anabaena, have been used as green manure to fertilize rice paddies and increase production. With the help of Azolla, rice can be grown year after year, several crops a year, with little or no decline in productivity; hence no rotation of crops is necessary. So, Azolla is an excellent biofertlizer. Thus (c) is correct option.

59. Which of the following is non-symbiotic biofertilizer?
(a) Anabaena (b) Rhizobium
(c) VAM (d) Azotobacter

Ans : **OD 2024, 2006**

Biofertilizers are organisms which bring about nutrient enrichment of the soil. Azotobacter is a free living, aerobic, nitrogen fixing bacteria. Anabena is a nitrogen fixing cyanobacteria that occurs in both free living and symbiotic associations with Azolla, Cycas roots, etc. Rhizobium lives symbiotically in root nodules of legumas and non-legumes. Vesicular-arbuscular mycorrhiza (VAM) is an example of endomycorrhiza in which fungal hypase penetrate the cortical cells of grasses to form vesicles.
Thus (d) is correct option.

60. Farmers have reported over 50% higher yields of rice by using which of the following biofertilizer?
(a) Cyanobacteria
(b) legume-Rhizobium symbiosis
(c) Mycorrhiza
(d) Azolla pinnata

Ans : **COMP 2006**

Azolla plays a very important role in rice production. Azolla and its nitrogen-fixing partner, Anabaena, have been used as green manure to fertilize rice paddies and increase production. With the help of Azolla, rice can be grown year after year, several crops a year, with little or no decline in productivity; hence no rotation of crops is necessary. So, Azolla is an excellent biofertlizer. Thus (d) is correct option.

61. Yeast (Saccharomyces cerevisiae) is used in the industrial production of
(a) tetracyline (b) ethanol
(c) butanol (d) citric acid

Ans : **FOREIGN 2016**

Saccharomyces converts starch on sugars to pyruvic acid through EMP pathway. Then this pyruvic acid is converted to acetaldehyde and finally to ethyl alcohol in the absence of oxygen. This entire process is called fermentation.
$C_6H_{12}O_6 \rightarrow 2CH_2COCOOH \rightarrow 2C_2H_5OH + 2CO_2$
This released carbon dioxide makes the dough to rise and gives spongy nature to bread.
Thus (b) is correct option.

62. Which of the following microorganisms is used for production of citric acid in industries?
(a) Aspergillus niger
(b) Rhizopus nigricans
(c) Lactobacillus bulgaris
(d) Penicillium citrinum

Ans : **SQP 2009**

Citric acid is obtained through the fermentation carried out by Aspergillus niger on sugary syrups. Citric acid is employed in dyeing, engraving, medicines, inks, flavouring and preservation of food and candies.
Thus (a) is correct option.

63. Biological control component is central to advanced agricultural production. Which of the following is used as a third generation pesticide?
(a) Insect repellent
(b) Organophosphateand carbamates
(c) Pathogens
(d) Pheromones

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SHORT ANSWER QUESTIONS

99. What do you mean by sewage? Describe the role of microbes in sewage treatment?

Ans : **OD 2018, SQP 2014**

The municipal waste water is called as sewage. It contains large amount of organic matter and microbes that are mostly pathogenic and leads to water pollution. Thus, need to be treated before discharging in natural water bodies. This is done in sewage treatment plants and microbes play an important mole in this process.

They are used in secondary biological treatment of sewage. In it, sewage is constantly agitated mechanically and air is pumped into it. This allows vigorous growth of useful aerobic microbes into flocs (masses of bacteria associated with fungal filaments to form mesh like structures.) These microbes consume major point of organic matter in the effluent. This significantly reduce the BOD of effluent. After this, the effluent is passed into a settling tank, where bacterial flocs are allowed to sediment.

This sediment is called activated sludge and is subjected for anaerobic digestion. The an aerobic bacteria grow in it, decompose the remain organic matter along with production of biogas.

100. Write the names of any four antibiotics produced by bacteria.

Ans : **OD 2014**

Antibiotic are drugs that inhibits the growth of or destroys micro organisms. Examples of antibiotic produced by bacteria are:

1. **Erythromycin :** Saccharopolyspora erythraea.
2. **Streptomycin :** Streptomyces griseus.
3. **Tetracycline :** Sreptomyces genus of Actinobacteria.
4. **Chloramphenicol :** Streptomyces venezuelae.
5. **Neomycin :** Streptomyces fradiae.

101. Write two advantage of use of fertilizer.

Ans : **OD 2011**

Advantages of bio-fertilizers area as follows :

1. They help to obtain high agricultural yield by making the soil rich with nutrients and useful micro-organisms necessary for the growth of the plants.
2. Promote plant growth they contain natural components which do not harm the plants but do the vice versa.
3. Bio-fertilizers destroy those harmful components from the soil which cause diseases in the plants. Plants can also be protected against drought and other strict conditions using bio-fertilizers.

102. Bacteria cannot be seen with the naked eyes, but these can be seen with the help of a microscope. If you have to carry a sample from your home to your biology laboratory to demonstrate the presence of microbes under a microscope, which sample would you carry and why?

Ans : **OD 2009**

The sample which can easily be carried from home to the biology laboratory to demonstrate the presence of microbes is a curd. The lactic acid bacteria i.e., Lactobacillus when added to the milk, convert the milk sugar lactose into lactic acid which coagulates the milk proteins and fats to form curd. It is a non pathogenic bacteria.

103. Give examples to prove that microbes release gases during metabolism.

Ans : **SQP 2020**

The best example to prove that microbes release gases during metabolism are (i) Formation of methane and CO_2 (fuel) gas in Biogas plants, (ii) Puffed-up appearance of dough used for making dosa, idly and bread, due to production of CO_2 gas by yeast- Saccharomyces cerevisiae, (iii) Production of CO_2 during production of wine and beer in breweries.

104. In which food would you find lactic acid bacteria ? Mention some of their useful applications.

Ans : **DELHI 2015**

Lactic acid bacteria are found mainly in the curd. They convert lactose sugar of milk into lactic acid, which coagulate milk fat and protein casein. They also improve the nutritional quality of curd by increasing vitamin B_{12}. Kaffir beer is prepared from soughum by Lactobacillus delbereuckii. Yoghurt is prepared from milk by Lactobacillus bulgarices. Lactic acid bacteria are nonpathogenic and are found in our stomach where they chack the growth of disease causing microbes.

105. Name some traditional Indian foods made of wheat, rice and Bengal gram (or their products) which involve use of microbes.

Ans : **COMP 2008**

(i) Angkak (Red rice) is prepared from rice by the microbes-Monascus purpureus.

(ii) Dosa and Idli is prepared from Rice and urad (Black gram) by the action of microbes-Leuconostoc and Streprococcus.

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Ans : DELHI 2013
The carbon dioxide (CO_2) released during fermentation is responsible for the rising of dough.

82. Name the bioactive molecules produced by Trichoderma polysporum and Monascus purpureus.
Ans : OD 2006

	Source		Bioactive molecule
(i)	Trichoderma	:	Cyclosporin-A
	polysporum		
(ii)	Monascus	:	Statins
	purpureus		

83. A farmer adds Azotobacter culture to the soil before sowing maize. How does it increase the yield of maize?
Ans : OD 2007
Azotobacter is a free-living nitrogen fixing bacteria. It fixes atmospheric nitrogen in the soil and increases the fertility of soil. Maize plants cultivated in fertile soil result in increased yield.

84. What is toddy?
Ans : DELHI 2019
The traditional drink of South India, prepared by fermenting sap from palm trees is called toddy.

85. Name the scientists who were awarded the Nobel Prize for discovering the potential of Penicillium.
Ans : SQP 2008
Alexander Fleming, Ernest Chain and Howard Florey.

86. What would have happened if antibiotics were not discovered?
Ans : OD 2008
The mortality rate would have increased due to no antibiotics

87. Why bottled fruit juices appear clearer?
Ans : DELHI 2011
Bottled fruit juices contain pectinase and protease. Due to their action, bottled juices appear clearer.

88. How do statins reduce the blood cholesterol level?
Ans : DELHI 2020
Statins act by competitively inhibiting the enzyme responsible for synthesis of cholesterol. Thereby, reducing the blood cholesterol level.

89. Explain the consequence if the oxygen availability to activated sludge flocs is reduced.
Ans : SQP 2019
The centre of flocs will become anoxic, which would cause death of bacteria and eventually the breakage of flocs.

90. Who developed the technology of biogas production in India?
Ans : FOREIGN 2015
Khadi and Village Industries Commission (KVIC) and Indian Agricultural Research Institute (IARI).

91. Name a beetle that is used to get rid of aphids.
Ans : COMP 2009
Ladybird.

92. Name a bacteria that is used in the form of sprays or sachets to control butterfly caterpillars.
Ans : FOREIGN 2020
Bacillus thuringiensis.

93. Name a species of virus used in biological control.
Ans : COMP 2015
Baculoviruses.

94. Name an example of a rod-shaped virus.
Ans : SQP 2009
Tobacco Mosaic Virus (TMV)

95. What makes the Nucleopolyhedrovirus a desirable biological control agent?
Ans : OD 2013
They are species specific and narrow spectrum insecticides; they have no negative impacts on other organisms.

96. Name the type of association that the genus-Glomus exhibits with higher plants.
Ans : OD 2014
The genus Glomus exhibits symbiotic association with higher plants, i.e. mycorrhiza.

97. Mention the role of cyanobacteria as a biofertiliser.
Ans : OD 2012
(i) Cyanobacteria can fix atmospheric nitrogen.
(ii) They also add organic matter to the soil to increase soil fertility.

98. Write names of some diseases which can be cured by antibiotics.
Ans : SQP 2009
Plague, whooping cough, diphtheria, leprosy, etc.

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note which was which. The BOD values of the three samples A, B and C were recorded as 20 mg/L, 8 mg/L and 400 mg/L, respectively. Which sample of the water is most polluted? Can you assign the correct label to each assuming the river water is relatively clean?

Ans : **DELHI 2015**

Biological oxygen demand (BOD) represents the amount of dissolved oxygen that would be consumed, if all the organic matter in one litre of water is oxidised by the microorganisms at 20° C. High value of BOD means the water is highly polluted by organic matter. Low BOD means water is either normal or less polluted by organic matter.

(i) Sample S-having BOD 20mg/L, is secondary effluent discharged from a sewage treatment plant.

(ii) Sample B having BOD 8 mg/L is river water.

(iii) Sample C having BOD 400 mg/L is untreated sewage water,

Through river water is clean, contains less organic matter, and thus it has least BOD value among all.

113. Find out the name of the microbes from which Cyclosporin A (an immunosuppressive drug) and Statins (blood cholesterol lowering agents) are obtained.

Ans : **OD 2018**

(i) Cyclosporing A is obtained from fungus Trichoderma polysporum, used in organ transplant patients.

(ii) Statin is produced by the yeast Monascus purpureus, acts by competitively inhibiting the enzyme responsible for synthesis of cholesterol.

114. Find out the role of microbes in the following and discuss it with your teacher.

(i) Single cell protein (SCP), (ii) Soil

Ans : **FOREIGN 2015**

(i) Single Cell Proteins (SCP) : Micro-organisms cultured on a commercial scale in a fermentor, treated variously, dried and used as food source or animal feed are celled **single celled proteins**. They are obtained form unicellular organisms e.g., Bacteria, yeast, filamentous fungi, algae etc. The total biomass obtained from unicellular organisms is called SCP. They are useful (i) rich in high quality protein and poor in fat contents (ii) can be produced all the year round in laboratories (iii) micro-organisms are fast growing, produce large amount of SCP, the cost of production is very less (iv) Substrates which otherwise cause pollution are used for production of SCP.

(ii) Soil : Soil is the most favourable habitat for a variety of microflora and fauna. They are mainly found in top layer of soil upto the depth of 5-15 cm. They increase the fertility of soil by nitrogen fixation or by decomposing organic matter The rhizosphere microorganisms have beneficial effect on the development of plants. The microorganisms produce CO_2 and form organic acids that in turn solublise the inorganic nutrient for the plants. Some of microorganism of rhizosphere produce growth stimulatins substance.

Soil also provides a mechanical (by anchoring) and nutritional (supply of nutrients) support to higher plants which are the producers of living world.

115. Arrange the following in the decreasing order (most important first) of their importance, for the welfare of human society. Give reasons for your answer.

Biogas, Citric acid, Penicillin and Curd

Ans : **COMP 2019**

(i) **Penicillin** : an antibiotic used to cure many bacterial diseases.

(ii) **Biogas** : an ecofriendly, non-polluting cheap, source of energy, specially in rural areas.

(iii) **Citric acid** : used as preservative of many food items.

(iv) **Curd** : a form of fermented milk easily digestible.

116. How do bio-fertilisers enrich the fertility of the soil?

Ans : **OD 2012**

Bio-fertilisers are the organisms which increase the nutrient availability to the crop plants either directly or through soil enrichment. They play role in increasing soil fertility and soil productivity. They are of three types-bacteria, cyanobacteria and mycorrhizal fungi. Bacteria and cyanobacteria function as biofertilisers because of their property of nitrogen fixation while mycorrhizal fungi preferentially withdraw minerals from decaying organic matter for the plant with which they are associated. Nitrogen fixation is the process of conversion of molecular of dinitrogen of the air into nitrogenous compounds.

Nitrogen fixing bacteria and cyano-bacteria may be free-living or form symbiotic association with the roots, stem & leaves of higher plants. For example Azolla-Anabaena association is of great importance to agriculture. Azolla pinnata is a free

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floating fresh water fern which multiplies rapidly doubling every 5-7 days. The fern can co-exist with rice plants because it does not interfere with their growth. In some south eastern countries especially. China and in southern states in India rice fields are regularly provided with **Azolla**. Anabaena azolla residing in the leaf-cavities of fern, fixes nitrogen. A part of fixed nitrogen is excreted in cavities and available to the fern. The decaying fern plants, release the same for utilization of the rice plants. When field is dried at the time of harvesting the fern functions as green manure decomposing and enriching the field for the next crop.

117. How is curd prepared? How preparation of curd improves nutritional value of the milk?

Ans : **COMP 2016**

Microorganisms such as Lactobacillus and others commonly called lactic acid bacteria (LAB) grow in milk and convert it into curd. During growth, the LAB produce acids that coagulate and partially digest the milk proteins. A small amount of curd added into the fresh milk as inoculum or starter contain millions of LAB which at suitable temperatures multiply, thus converting milk to curd, which also improves its nutritional quality by increasing vitamin B_{12}. In our stomach the LAB play very beneficial role in checking disease causing microbes.

118. How is Lactic acid produced? Write down its uses.

Ans : **FOREIGN 2011**

Lactic acid was the first organic acid to be produced from microbial fermentation of lactose (milk sugar). Fermenting agents are bacteria (e.g., Streptococcus lactis and Lactobacillus species) and fungi (e.g., Rhizopus). The acid derived from fungal sources is costlier but is of high purity.

$$\underset{\text{Lactose}}{C_{12}H_{22}O_{11}} + H_2O \rightarrow 4\underset{\text{Lactic acid}}{CH_3CHOHCOOH}$$

Uses : Lactic acid is used in confectionery, fruit juices, essence, pickles, canned vegetables and fish products. It is also employed as mordant in tanning, printing of wool, plastic and pharmaceuticals.

119. Name few household products and the name of the microbes used in their preparation.

Ans : **FOREIGN 2011**

(i) **Curd** - Lactobacillus acidophilus

(ii) **Yogahurt** - Streptococcus thermophilus, L. bulga- ricus

(iii) **Butter milk** - Streptococcus cremoris, S, lactis, Leuconostoc species L. acidophilus

(iv) **Sour cream** - S. lactis

(v) **Cheese** -

(a) cottage cheese - S. lactis and Lactobacillus

(b) Swiss chesse - large holes - Penicillium sharmanii.

(c) Roquefort cheese - Penicillium roqueforti

(d) Camembert cheese - P. camemberti

(vi) **Bread** - Saccharomyces cerevisiae

(vii) **Dosa**, **uppma and idli** - Leuconostoc and Streptococcus spps.

(viii) **SPC (Single cell proteins)** - Spirulina, yeast, Fusarium graminarum.

120. Describe the action of various enzymes secreted by yeast in fermentation.

Ans : **OD 2013**

Yeast secretes three types of enzymes, which act in different stages during fermentation (i) Amylases break starches into maltose (a disaccharide) (ii) Maltasses break maltose into glucose and fructose (iii) Zymase a complex of several enzymes break glucose and fructose into ethyl alcohol and carbon dioxide.

121. What is a broad spectrum antibiotics?

Ans : **FOREIGN 2015**

It is an antibiotic which have the ability to kill or destroy several pathogens belonging to different groups with different structure and wall formation. Antibiotic molecules generally disrupt a vital link in the metabolism of microbe.

122. Discuss in brief the general methods for the production of antibiotics.

Ans : **DELHI 2012**

General methods for the production of antibiotics include following steps:

(i) Suitable strains of microorganisms are cultivated in a specialized sterilised nutrient medium.

(ii) The microorganisms excrete out certain chemicals into the medium called as antibiotics.

(iii) As microorganisms are removed by filtration and centrifuging and the antibiotics are isolated from the medium by method of solvent extraction, absorption and precipitation.

(iv) The antibiotics thus formed are purified concentrated and bioassayed before packing.

123. Describe the properties of good antibiotics.

Ans : **COMP 2016**

Properties of antibiotics :

(i) Antibiotic should have a broad spectrum.

(ii) It should be quick in action, and do not allow microorganism to develop the resistance.

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(iii) It should not be harmful nor should it have any side effect in the body of host.

(iv) Normal microbial organisms of the host gut should not be destroyed.

124. What are the uses antibiotics ?

Ans : **OD 2016**

Following are some of the uses:

(i) As medicine against pathogenic diseases.

(ii) As preservative in perishable fresh food articles e.g., meat, fish.

(iii) A feed supplement for animals especially poultry birds.

125. How do antibiotic function?

Ans : **DELHI 2019**

Antibiotics do not have similar effects on all harmful microbes. All of them inhibit growth or kill and destroy bacteria, viruses and fungi. Actually antibiotic molecules act either by (i) Disruption of wall synthesis (ii) Disruption of plasmalemma repair and synthesis (iii) Inhibition of 50 S ribosome function (iv) inhibition of 30 S ribosome function (v) inhibition of aa-tRNA binding to ribosome.

126. Name the bacterium responsible for the large holes seen in Swiss Cheese. What are these holes due to?

Ans : **SQP 2008**

Name of bacterium : Propionibacterium sharmanii.

The large holes in the **swiss cheese** are due to the release of CO_2 as a result of alcoholic fermentation. The alcohol evaporates in the process and the CO_2 produce puffing appearance.

127. Explain the role of flocs in sewage treatment.

Ans : **OD 2005**

Flocs representing aerobic microbes such as bacteria associated with fungi consume the major part of the organic matter of the effluent by external digestion through the secretion of enzymes. They, thus reduce BOD (biochemical oxygen demand) of the effluent.

128. What is fermentation? What are the conditions that favour fermentation?

Ans : **DLEHI 2009**

Fermentation is the anaerobic decomposition process in which organic acids. Alcohols and gases are evolved from nutrient contain microorganisms. These gases are usually waste products of metabolism of the microbes e.g., CO_2 produced during alcoholic fermentation.

Conditions :

(i) **Temperature** : A temperature between 25° C to 35° C. At high temperature the microbes are destroyed and at low temperature, their action slows down.

(ii) **Concentration** : Dilution favours fermentation.

(iii) **Air** : presence of air is necessary which improves the activity of enzymes.

(iv) **Presence of foreign substances** : Presence of Hg. Pb, AI, Sn, Zn destroy the activity of enzymes but presence of PO_4^{3-} increase the activity of enzyme.

129. Write the various major steps of fermentation.

Ans : **FOREIGN 2009**

The major steps of fermentation are as follows:

(i) Sterilisation of the fermentors/bioreactor and nutrient medium in steam, under pressure.

(ii) Inoculation of selected strain of the yeast.

(iii) Recovery of the product.

130. Name the microbes and the organic acids produced with their helps.

Ans : **COMP 2013**

(i) Acetic acid : Acetobacter aceti.

(ii) Citric acid : Aspergillus niger and Mucor sps.

(iii) Lactic acid : Streptococcus lactis and Lactobacillus sps. Rhizous sps.

(iv) Gluconic acid : Aspergillus niger and penicillium sps.

131. Name two commonly used bioreactors. State the importance of using a bioreactor.

Ans : **OD 2020**

(i) Simple stirred tank bioreactor

(ii) Sparged stirred-tank bioreactor

Importance :

(i) Even-mixing and oxygen availability through the bioreactor.

(ii) Provides optimal conditions for growth such as temperature, pH and foam control systems, sampling ports etc.

(iii) A large amount of the raw material substrates are biologically converted into specific products such as vitamins, enzymes, etc., on commercial scale.

132. Name the two different categories of microbes naturally occurring in sewage water. Explain their role in cleaning sewage water into usable water.

Ans : **SQP 2019**

The sewage water contains very useful aerobic

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absorbed by the plants and the bacteria get nourishment in return from plant exudate. For example, Azospirillum lipoferum with the roots of Maize and Brazilian grasses.

161. Describe the role of microbes in the production of bio-gas from cattle dung and agricultural waste.

Ans : **OD 2008**

Biogas is a mixture of gases containing mainly methane which is produced by the microbial activity. It is mainly used as a fuel. The constituents of biogas depend upon the constituents of the raw organic material and the microbes present in it. It is produced from the cattle dung (animal excreta commonly called gobar) by the collective activity of several bacteria named methanogens, one such common bacteria is Methanobacterium. These bacteria are anaerobic in nature. They break down the cellulose of the animal excreta and agricultural wastes by secreting enzyme cellulose which converts cellulose into short chain fatty acids like propanoic acid, acetic acid, butyric acid, etc. Thus, the excreta of cattle commonly called gobar has a large number of these bacteria also. Dung is also rich in undigested cellulose and its cellulosic dericatives from plants and a large number of methanogens. These generate biogas.

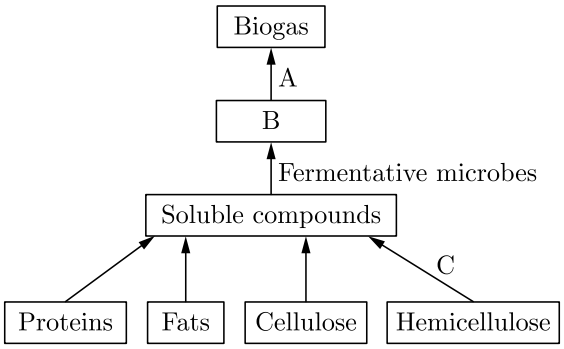
162. Describe the structure of a Biogas plant.

Ans : **DELHI 2009**

Biogas plant consists of a **pucca** concrete circular, tank which is about 10 feet deep in which semisolid dung (slurry) is fed through a hole and a short connected feeder canal. An iron floating cover is placed over slurry, which works as a storage tank. It is airtight in the tank. It keeps on rising as the gas is produced in the tank due to the anaerobic microbial activity. The iron float has a hole and a short pipe is welded to it. This outlet is connected to a pipe to carry biogas to nearby houses, where it can be used for cooking the food etc. The spent slurry is removed through another outlet and can be used as manure in the fields. These biogas plants can be used an manure in the fields. These biogas plants can be used successful in villages where the people have several cattles which are used for tilling the land, providing link, carting and a variety of purposes. Cattle dung is available in plenty in rural areas. This biogas plant technology was developed in India by IARI (Indian Agricultural Research Institute, Delhi) and Khadi and Village Industries Commission (KVIC). Here the cattle dung is used for two purposes by the rural people i.e., for cooking the food etc. and manuring the fields for better cropping. Government of India and state governments give subsidies for the installation of gobar gas (biogas) plants to the people. It saves a lot of wooden and dung fuel and also improves the health of the ladies as there is no smoke which affects the eyes and the lungs. Thus, along with savings, the health also improves.

CASE BASED QUESTIONS

163. Villagers in a place near Chambur started planning to make power supply for agricultural purposes from cow dung. They have started a biogas plant for the purpose. Study the flow chart for biogas production given below and answer the following questions.



(i) Mention the major component of biogas.

(ii) Identify 'B' in the flow chart?

(iii) What does A depicts in the given flow chart?

(iv) What are advantages of biogas?

Ans :

(i) Biogas is a mixture of gases such as methane, hydrogen sulphide and carbon dioxide. It is used as source of energy as it is inflammable.

(ii) In the second stage of biogas production, the simple soluble compounds or monomers are acted upon by fermentation causing microbes and converted into organic acids especially acetic acid.

(iii) A is methanogenic bacteria that converts organic acids as well as carbon dioxide into methane. The gas thus formed is stored in tanks for supply.

(iv) (a) Biogas is used for cooking and lightning.
(b) It provides both energy and manure.
(c) It is a storable form of energy which can be used more efficiently and economically.

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(v) result in overall increase in the plant growth and development.

139. Name any two cyanobacteria and explain how they serve as main sources of biofertilisers.

Ans : COMP 2009

The two cyanobacteria which serve as biofertilizers are Nostoc and Anabaena. They possess heterocysts and fix stmospheric nitrogen into ammonia. The fixed form of nitrogen leaches out into the soil where it absorbed by higher plants. In this way, the cyanobacteria serve as main source of biofertilisers.

140. Name the water fern that is an excellent biofertilizer for rice cultivation. What helps the fern to do so?

Ans : OD 2015

Azolla - A most useful cyanobacterial biofertiliser is Azolla - Anabaena symbiosis which is an excellent biofertiliser for rice cultivation. The atmospheric nitrogen is fixed by cyanobacteria - Anabaena azollae. After death, azolla plants add manure to the fields, which is consumed by rice crop.

141. Describe the functions of anaerobic sludge in a sewage treatment plant.

Ans : DLEHI 2012

During the secondary treatment when the BOD of sewage is reduced significantly in aeration tank, the effluent is passed into settling tank, where the flocs are allowed to sediment forming activated sludge.

Functions :

(i) A small part of activated sludge is pumped back into aeration tank to serve as the inoculum.

(ii) Major part of activated sludge is pumped into large tanks called anaerobic sludge digesters.

(iii) Here anaerobic bacteria, digest the bacteria and fungi in the sludge producing CH_4, H_2S and CO_2, i.e., Biogas. It can be used as a source of energy as this mixture (Biogas) is inflammable.

142. Define enzymes. What are the drawbacks of use of enzymes in biotechnology as compared to inorganic catalyst?

Ans : SQP 2013

Enzymes are proteinaceous substances of biological origin which are capable of catalysing biochemical reactions without themselves undergoing any change.

Drawbacks of use of enzymes in Biotechnology :

(i) Extraction and purification of enzymes is not only laborious but also highly expensive.

(ii) Enzymes are not stable and are quite fragile.

(iii) Enzymes are denatured at slightly higher temperature than room temperature.

(iv) Changes in pH deactivates the enzymes.

(v) Enzymes are influenced by a number of organic solvents, exposure to air or protein poisons. However, there is no alternative to enzymes.

143. Write a short note on microbial biocontrol agents.

Ans : FOREIGN 2020

Microbial biocontrol agents are the microbes which are used to control the pest of the crops. For example (i) In order to control butterfly, caterpillars, bacteria Bacillus thuringiensis are used. The bacteria are available in the market in sachets as dried spores which are mixed with water and sprayed on to susceptible sensitive plants such as Brassica and fruit trees which are eaten by the insect larvae. In the gut of the larvae, the toxin is released and the larvae get killed. The bacteria will kill the caterpillars but leave other insect unharmed. (ii) The fungus Trichoderma species are free-living commonly found into root ecosystem. They are effective biocontrol agents of several plant pathogens.

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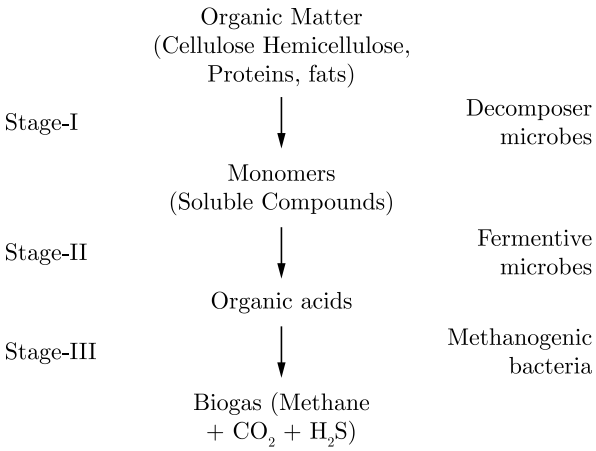
144. Give a schematic sketch of different stages in Biogas formation:

Ans : SQP 2009

Different stages in Biogas formation are as under:



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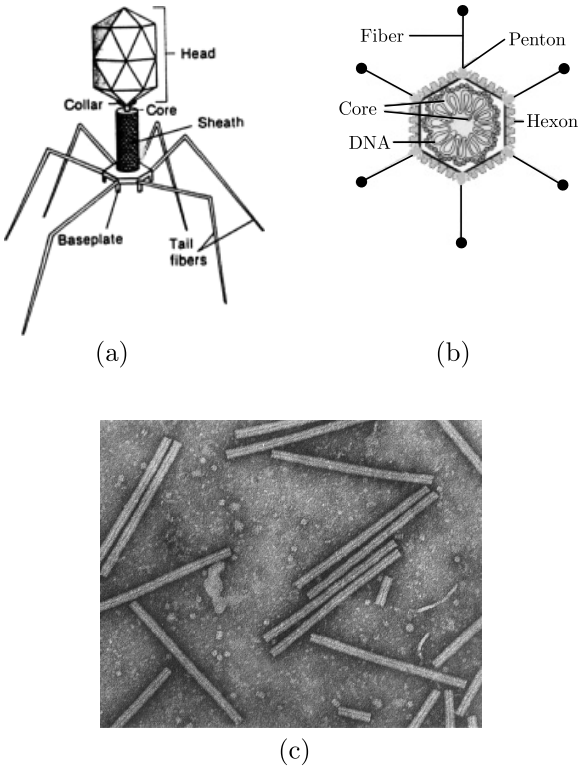


(a) (b)

(c)

Fig Viruses (a) A bacteriophage (b) Adenovirus which causes respiratory infections (c) Rod-shaped Tobacco Mosaic Virsus (TMV)

152. Enumerate the unique features of Microbes.

Ans : **SQP 2015**

Some main features are as follows :

(i) The microbes are microscopic in size. A bactertial cell measures $1-3\,\mu m$ (micrometer) in its largest dimensions. The viruses are more smaller.

(ii) **Spores** formed by some microbes to withstand unfavorable circumstances. The **capsule** is a slimy layer covering of the microbe protects it against **desiccation**. It can also be seen with optical **microscope**.

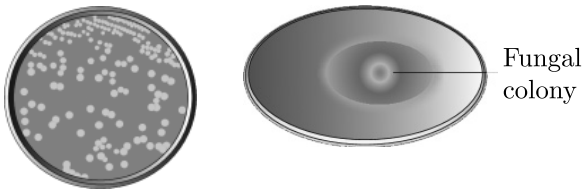
(iii) The bacteria may be stained with dyes e.g., crystal violet or safranin by a method known as the **Gram staining**. Then they become easily visible under an optical microscope.

(iv) The **flagella** as well as pili are seen under electron microscope.

(v) The **intracellular details** of microbes may be seen well only be electron microscope that magnifies individual microbial cells to 50,000 – 4,00,000 times. It gives greater resolution.

(vi) They can be grown an nutritive medium to make colonies.

(vii) Microbes cause diseases in humans, plants and animals.



(a) (b)

Fig (a) Colonics of Bacteria Growing in Petri dish (b) Fungal Colony Growing in a Petridish.

153. What is sewage? What is BOD? Give the effects of sewage contamination and methods to prevent sewage pollution.

Ans : **DELHI 2007**

Sewage : Large amount of waste water in cities and towns is generated daily. Excreta of humans are mixed in it. This municipal waste water is **sewage**. It has **microbes** in excess. It includes community waste. The waste water from, industries and houses etc. are community waste.

In strict sense sewage contains human and animal excreta, food residues, cleaning agents, detergents and other wastes. It is very rich in bacteria and organic substrata.

The most important property of the community discharge is its peals responsibility.

BOD : The pollution strength is usually characterized by its **biological Oxygen Demand** (BOD). BOD is the amount of Oxygen taken up by the microorganisms present in water.

In addition many toxic substances enter the sewage system from factories and industrial house. These may be in the form of heavy metals, cyanide oil and similar substances.

Effects of Sewage contamination :

(i) Sewage contamination of water affects many physical and chemical changes in water.

(ii) It changes the turbidity of water.

(iii) It causes increase in BOD i.e., Biochemical oxygen demand.

(iv) Germas and bacteria found in sewage water cause many disease.

(v) The water is not fit for drinking.

Prevention of Sewage Pollution :

(i) Water should be boiled before use.

(ii) Domestic wastes and sewage should not be released into rivers and canals.

(iii) Industrial wastes and oil should not be thrown into river water.

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beverages like wine, beer whiskey, brandy and rum. eg. **S. Cerevisiae** is used for formation of ethanol from malted cereals and fruit juices.

Several species of fungi and bacteria are used for production of antibiotics. The first antibiotic was penicillin obtained from mould **Pencillium notatum-** Other examples are, streptomycin in is obtained from **streptomycin risers**, Bacitracin is cultured from **Bacillus subtilis.**

Besides this, several organic acids, Enzymes, bioactive molecules are also commercially produced with the help of microbes.

(iii) **Use of microbes in sewage treatment :** Microbes are used secondary biological treatment of sewage water. This occurs in two steps. In first step, aerobic microbes are used to form flocks that digest organic waste and significantly reduce BOD of sewage. In next step, anaerobic microbes such as methanogens are used which further digest the organic matter of sewage along with the production of biogas. After this, solid waste is used as biofertilizer in farm while effluent water is discharged into natural water bodies.

(iv) **Use of microbes as biological control :** Several microbes are being used for controlling plants disease and pest such as Bacillus thuringiensis is used for formation of several genetically engineered pest resistant varieties of crop of control insects of order Lepidoptera, diopetra etc. eg. Bt cotton. Baculovirus of genus nucleopoly hedrovirus are used in over all integrated pest management program to check growth of several pest species.

(v) **Use of microbes as bio-fertilizers :** Several microbes such as hizobium, Azotobacter, Azospirillum, Anabena, nostoc etc. are used in agriculture fields for increasing fertility of the soil.

150. Describe in brief: Microbes as biofertilizers.

Or

What are the types of biofertilizers? How does the soil benefit from them?

Ans : **OD 2014, SQP 2012**

Biofertilizers is a organic manure, composed of living micro organisms, which when applied to crops in field, promotes growth by increasing the supply or availability of primary nutrients to the host plant.

Chemical fertilizers directly increase soil fertility by adding nutrients to soil where as biofertilizers add nutrients through a natural process of fixing atmospheric nitrogen, solubilizing phosphorous and stimulating plant growth by producing growth promoting substances.

Classification of Biofertilizers - The major classes of biofertilizers are as follows:

(i) **Nitrogen fixing biofertilizers:** eg. Azotobacter, clostridium, Anabena, Rhizobium, Azospirillum etc.

(ii) **Phosphorous solubilizing Biofertilizers:** eg. Bacillus, Circulans, Pseudomonas striata, Penicillium sp. etc.

(iii) **Phosphorous mobilizing Biofertilizers:** eg. Laccaria sp., glomus sp., etc.

(iv) **Plant growth promoting Rhizobacteria:** eg. Pseudomonas fluorescens.

Advantages of biofertilizers :

(i) They help to obtain high agricultural yield by making the soil rich with nutrients and useful microorganisms necessary for the growth of the plants.

(ii) Promote plant growth they contain natural components which do not harm the plants but do the vice versa.

(iii) Bio-fertilizers destroy those harmful components from the soil which cause diseases in the plants. Plants can also be protected against drought and other strict conditions using bio-fertilizers.

(iv) They are not costly and even poor farmers can make use of them.

(v) They are environment friendly and protect the environment against pollutants.

151. What are viruses ? Give an account of them.

Ans : **OD 2018**

They are particle like and may be crystallized. These are **inert** outside the host but active. Viruses cause **diseases** in plants and animals. Virus means **poisonous fluids**. The viruses are at the border line of **living and non-living**. They have DNA or RNA as their genetic material. Viruses are enclosed by a protein coat. **D.J. Ivanowsky** (1892) recognized them **as causal organisms** of **TMV disease**. They are filterable. **M.W. Beijerinick** (1898) showed that the extract of infected plants of tobacco may cause infection in healthy plants. This fluid/ extract is called **infectious living fluid** (contagium, vivum fluidum). **W.M. Stanley** (1831) explained that virus may be crystallized. These crystals are stored in bottles for many years. Virus cause diseases like mumps, small poxs, flue, AID's etc.

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microbes

(i) **bacteria** associated with

(ii) **fungal hypha**.

The two together form **flocs,** the mesh like structures.

These microbes multiply using biodegradable organic substances as substrates and hence utilise some of the components of the sewage/ effluents. They use a large amount of oxygen in decomposition. This significantly reduces the BOD of the effluent. It is possible to estimate the organic matter in sewage by measuring BOD (Biochemical oxygen demand). The greater the BOD of waste water, more is its polluting potential.

After this, from aeration tank, the effluent is passed to settling tank where the sedimented flocs form activated sludge. The effluent from settling tank is clean, usable and can be released into fields or rivers and streams.

133. Write a note on Mycorrhiza.

Ans : **OD 2016**

Mycorrhiza is an symbiotic association between fungus and roots of higher plants. It is of two types Ectomycorrhiza and Endomycorrhiza.

(i) **Ectomycorrhiza** : Here, fungal mycelia form mantle on root surface. From the mantle fungal hyphae penetrate into cortex of root as well as into the soil. This leads to increase in surface area for absorption of water and minerals (N, P and K). Fungal hyphae in soil further solubilise some insoluble organic compounds which are easily absorbed by plants. Ectomycorrhizae have been found in oaks, pines, and Eucalyptus.

(ii) **Endomycorrhiza** : Here, fungus does not form a mantle on root surface, instead it produce loosely interwoven hyphae. Some of these mycelia penetrate into soil still others enter into cortical cells or root to function as Haustoria (VAM fungi).

134. What are (i) Herbicides and (ii) Bioherbicides ? Describe two main drawbacks of using chemical weedicides.

Ans : **COMP 2008**

(i) Herbicides are those chemicals which are used to control the weeds (unwanted plants) in crop fields.

(ii) **Bioherbicide** involves the biological control of weeds by some living organisms. It involves the use of insects feeding on a specific weed or use of certain micro-organisms which will cause disease in weeds.

Drawbacks of use of chemical weedicides:

(i) Improper use of herbicides may damage the crops.

(ii) They encourage the growth of resistant weeds.

135. Why is Rhizobium categorized as a **symbiotic bacterium**? How does it act as a biofertiliser?

Ans : **FOREIGN 2007**

Rhizobium is a **symbiotic bacteria** as it lives in mutually beneficial association in the nodules on the roots of leguminous plants. The bacteria fix atmospheric nitrogen into organic forms, which is used by the plant as nutrient and in turn bacteria get carbohydrate food and shelter. The leguminous plants with modulated roots are ploughed back into the field as green manure. They act as biofertilisers that enrich the nutrient quality of the soil. Beside inorganic nutrients, they also add organic matter to the soil, thereby also improving the texture of the soil.

136. Why are leguminous plants cultivated as green manure crop?

Ans : **DELHI 2019**

Leguminous plants possess small swellings-root nodules where atmospheric nitrogen is fixed by symbiotic bacteria-**Rhizobium**. The fixed nitrogen fertilizes the soil. Moreover, the green plants after their death and decay add manure to the soil e.g., Crotolaria, Sesbania, Cyamopsis, Trifolium etc.

137. What is the biological significance of ectomycorrhizae in peach orchards?

Ans : **OD 2020**

The ecromycorrhizae has following functions in peach orchards:

(i) Absorption of water

(ii) solubilisaton of complex organic molecules into simple inorganic nutrients.

(iii) protection of plants from attack of disease causing pathogens etc.

138. What are the benefits of fungus to the plant in mycorrhiza?

Ans : **SQP 2015**

Fungi form symbiotic association with roots of higher plants (mycorrhizae) e.g., Glomus, Benefits of mycorrhizae are:

(i) the fungus absorbs phosphorus and passes it on to the plant.

(ii) provide resistance against root-borne pathogens.

(iii) provide tolerance to salinity.

(iv) provide tolerance to drought.

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154. Name the equipments used for microbial culture. Mention any one in detail.

Ans : **SQP 2006**

The microbes are cultured in **test-tubes** or **ordinary Erlenmeyer flasks** in about 100-1000 ml volumes. **Shakers** may be used for it. **Baffle flasks** are used to improve the microbial growth by increasing efficiency of O_2 transfer to culture medium. The **fermentors** or **bioreactors** are vessels used for large scale growth of microbes in a controlled environment.

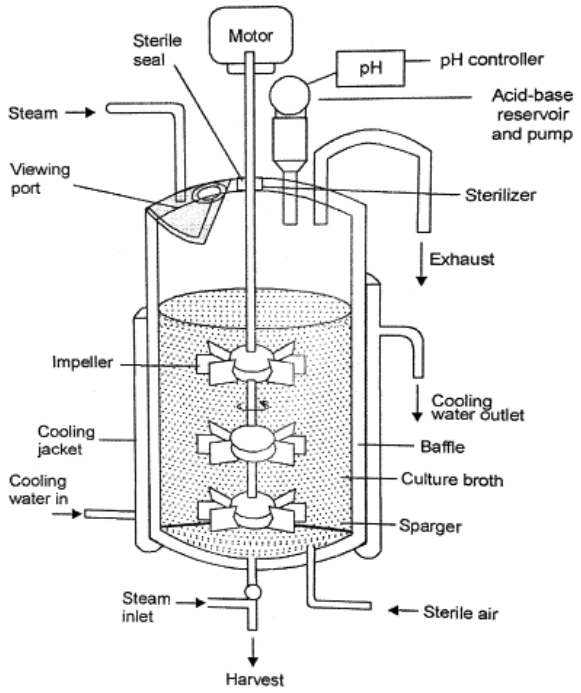

Fig Basic design of a fermentor (Bioreactor)

155. Discuss the biological methods for the control of insect pests.

Ans : **DELHI 2009**

Biological Control of Insect Pests : Biological control of insects pests include the following methods :

(i) **Pathogens, Parasites and Predators** : The destructive insect pests which destroy the crops can be controlled by the introduction of certain pathogens, parasites and predators. For example **aphids** which such the plant juices, can be controlled by the introduction of **lady bugs or praying mantis**. These eat the aphids.

(ii) **Sterilization Strategy** : The screw worm, a major pests was eradicated by releasing sterile male insects (rendered sterile by irradiation) at the time of mating to compete with natural fertile population.

(iii) **Insect Hormones** : Insect hormones are used for pest control. Such hormones are called pheromones. The insect hormones such as the juvenile hormone and the moulting hormone (ecdysone) are required for the proper and metamorphosis of young ones to adult stage. These two are given to the insects at any early stage a result of which the insects undergo inappropriate transformation into giant larvae and immature adults which quickly die.

156. What are mycorrhizae ? Distinguish between the occurrence of the types of mycorrhizae. How do they enrich the soil?

Ans : **FOREIGN 2019**

Mycorrhizae is a symbiotic association of certain fungi with the roots of certain seed beating plants. There are two types of mycorrhizae :

(i) Ectomycorrhizae.

(ii) Endomycorrhizae.

Difference between Ectomycorrhizae and Endomycorrhizae are as follows :

	Ectomycorrhizae	**Endomycorrhizae**
(i)	It is a form of mycorrhizae association in which there is a well developed mycelium forming a mantle on outside of the root.	It is a form of mycorrhizae association in which the fungus lives between and within the cells of the cortex and growth on outside of root is limited.
(ii)	Mycorrhizae increases water and nutrient uptake resultin g in greater plant vigour, growth the yield. This type of mycorrhizae is found in the roots of trees like Oak, pine, eucalyptus etc. They absorb and store N_2 , potassium and calcium in their fungal mantle.	This type of associations is found in man orchids and some woody plants. It is produced by bothseparate and non-separate fungi. There is a form of eWndotropic mycorrhizae where fungus lives between the cells of cortex and form VAM for phosphate nutrition.

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157. What are various forms of bacteria ?

Ans : **DELHI 2009**

Bacteria has a definite form and shape. They are classified as given below :

(i) **Cocci** : They are oval or shperical in shape. When they occur singly, they are called Micrococus ; if in pairs - **Diplococcus**; if in a chain- **Streptococcus**; and if occur in clusters - **Staphylococcus**. Shape of bacteria may change according to time, habitat and medium. This characteristic of bacteria is known as **polymorphism** e.g. Azotobacter.

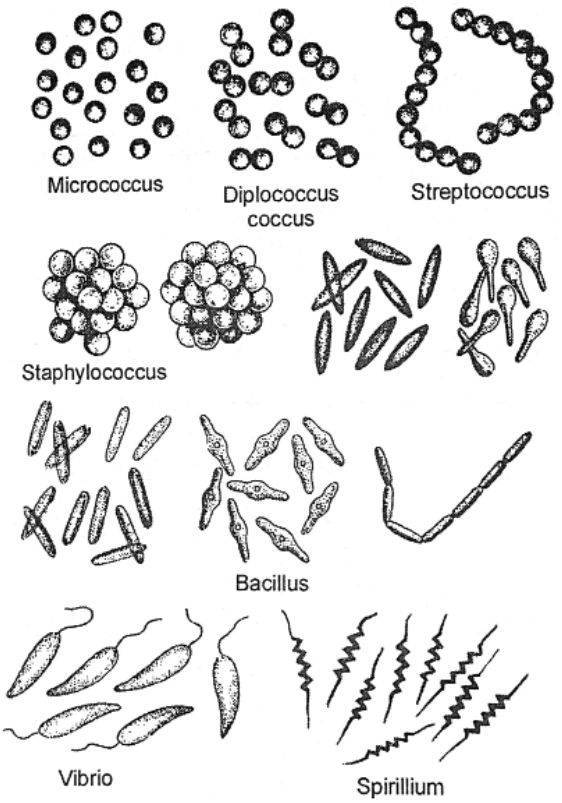

Fig Various Morphological orms of Bacteria

(ii) **Bacilli** : They are rod-like, with or without flagella. Flagella may be present at one or both the ends or around cells. Bacteria may occur singly - **bacillus**; or in pairs - **diplobacillus** or may form filaments - **streptobacillus**.

(iii) **Vibrio** : They are small and curved like **commas**. These are mostly motile. These have a flagellum at one end.

(iv) **Spirillum** : These are twisted like a screw. They have flagella at one end or both the ends. Certain bacteria possess flagella for locomotion. The **bacterial flagellum** is made of a single protein molecule only.

158. What is sewage treatment ? Explain its steps with the help of a diagram of STP.

Or

Explain the different steps involved in average treatment before it be released into natural water-bodies.

Or

Explain the process of sewage water treatment before it can be discharged into natural water bodies. Why is the treatment essential?

Ans : **OD 2015**

Waste water generated by household activity, industries or garbage landfills is called sewage. The treatment of waste water is based upon its use. The following three types of treatment is carried out:

(i) **Primary treatment :** The following steps are performed in the primary treatment of water : (a) sedimentation, (b) coagulation, (c) filtration.

(a) **Sedimentation :** This step is carried out in large tanks specially built for this purpose in a sewage treatment plant. The polluted water is allowed to settle so that silt, clay and other matter settle to the bottom and water is slowly allowed to move out.

(b) **Coagulation :** Fine particles and colloidal suspension are combined into large particles by the process of coagulation. This is carried out by the addition of coagulants or flocculates like potash alum. The large particles either settle to the bottom or form suspension.

(c) **Filtration :** Suspended particles, flocculates, bacteria and other organisms are filtered off by passing the water through a bed of sand or finely divided coal or through some fibrous disc. The impurities collected in the primary treatment of water are called sludge This is used as a valuable fertilizer. On composting, it releases sludge gas, which mainly contains methane gas which is used for cooking purposes.

Fig Secondary Treatment

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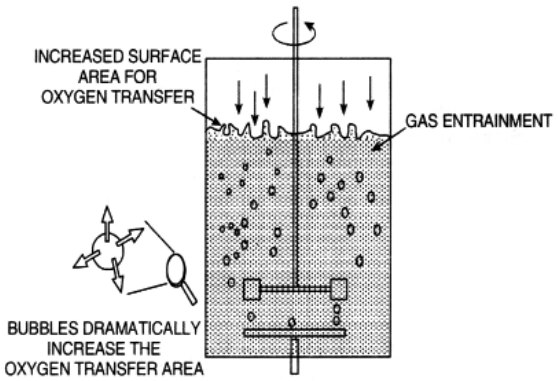
(ii) **Secondary Treatment** : This is also called **biological treatment**. In the water after primary treatment is not fit for drinking purposes and has to undergo further treatment.

(iii) **Tertiary Treatment of Water** : This step is disinfecting water. Chlorine is the most commonly used disinfectant used for killing bacteria. But, chlorine also reacts with organic matter present in water and forms undesirable chlorinated hydrocarbons which may be toxic and potentially carcinogenic. Thus it is essential to reduce the organic matter in water before passing chlorine gas. Other methods of disinfection such as ultraviolet radiation, ozone gas treatment or reverse osmosis are preferred over chlorine treatment. But these methods are more expensive.

159. What is bioreactor? Draw a labelled diagram of a sparged-stirred bioreactor. Explain its functioning.

Ans : SQP 2019

Bioreactor : A bioreactor is a huge vessel where a desired product is obtained in large quantities. App 100-1000 litres of culture if needed, can be processed in it.



Stirred Tank Bioreactor : This type of bioreactor has flat base for mixing the contents in it. The stirrer is used for it and to maintain O_2 supply in it. Air is bubbled in the bioreactor. There are many systems in it such as for the temperature control, pH control, form control as well as the O_2 delivery systems etc. The small volume of cell cultures are taken out after some time. The desired product may be archived.

160. Describe the main sources of biofertilisers, giving suitable examples.

Ans : COMP 2006

Biofertilizers are organisms which enrich the soil with nutrients. The main sources of biofertilizers are bacteria, cyanobacteria and fungi. These are described as follows:

(i) **Legume-Rhizobium symbiosis** : Legum-inous plants show symbiotic relationship with nitrogen fixing bacteria Rhizobium.

(ii) **Azolla-Anabaena symbosis** : Anabaena are cyanobacteria, which live in symbosis with fern Azolla. Anabaena fixes atmospheric nitrogen. Azolla and cyanobacteria Nostoc are added to rice fields to increase the yield. Azolla grows rapidly in the fields, finally decays and add nitrogen content to the soil.

(iii) **Free-living bacteria** : These are asymbiotic, aerobic and anaerobic bacteria which fix atmosphere nitogen under poor aeraction conditions. Some of them are saprotrophic, living on organic remains. For example : Azotobacter, Bacillus, Clostridium etc.

(iv) **Free-living Cyanobacteria** : Cyanobacteria or blue-green algae are widely used as biofertilizers. They have thick walled heterocysts which fix atmosphere nitrogen. For example, Anabaena, Nostoc, Aulosira. These are capable of photosynthesis and can supply nitrogen to entire rice crop. These are simple to use and very cost effective.

(v) **Mycorrhiza** : Some fungi live symbiotically in the root of higher plants. This mutually beneficial association is termed as Mycorrhiza. These may be of two types : Ectomycorrhiza, where fungus hyphae form a mantle on root surface and penetrate into cortex of roots. This increases the surface area for absorption of water and minerals like N, P and K. These also solubilize some insoluble organic compounds. For example, they are found in euclayptus, pine, oaks etc.

Endomycorrhiza : The fungus lives in the intercellular spaces of the cortex and hyphal tips enter cortical cells of the roots. For example, orchids, cereals, grasses, citrus, rubber, tea etc.

(vi) **Microphos Biofertilizers** : Some microorganisms solubilize bound phosphate of soil and make it available for plant absorption. For example, Pseudomonas striata and Bacillus polymyxa and fungi - Aspergillus.

(vii) **Loose association of Nitrogen fixing bacteria** : Some bacteria live in close contact with the roots of grasses and cereals, called associative symbiosis. They fix nitrogen, which is

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145. How do mycorrhizae act as biofertilizers? Explain name a genus of fungi that forms a mycorrhizal association with plants.

Ans : **DELHI 2016**

The fungal symbiont in the mycorrhizae.

(i) Absorbs phosphorus from the soil and passes it to the plant

(ii) provide resistance to root-borne pathogens.

(iii) tolerance to salinity and drought.

(iv) overall increase in plant growth and development.

Many species of Glomus form mycorrhizal association with plants.

146. What are viruses parasitising bacteria called? Draw a well labelled diagram of the same.

Ans : **OD 2013**

Bacteriophage : Virus infecting bacteria are known as bacteriophage. These were invented by **Edward Twort** (1925) and **d'Heralle** (1917). These obligate parasites occur in Salive, blood, intestine. The phages possesses a **tail** and a **head**. The viral DNA is thread like ds (double stranded) macromolecule. There are 4 segments of the tail. Bacteriophages are of two types : (i) **lytic** and (ii) **Lysogenic phges** e.g., (lambda) phage, T_2 phage etc.

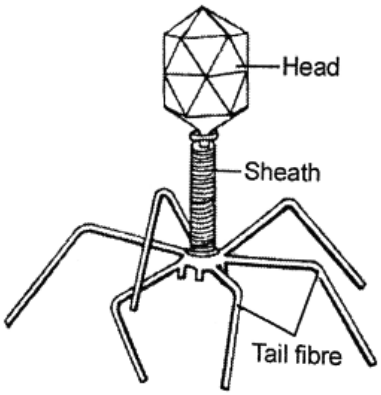

Fig Bacteriophage

147. By figures explain the structural features of E. coli.

Ans : **DELHI 2010**

The bacterial **cells** vary in **size**. The smallest bacterial cells are about 100-200 nm. Some cubacterial cells are $2.0 - 2.6\,\mu m$ long and 1.1 to $1.5\,\mu m$ in width. Some bacteria and BGA are 500 mm in length. **Example** : Oscillatoria and Spirochretes. Epulopscium fishesion is found in the intestine of brown sturgeon fish is a blue green alga. E. coli has pili and flagella.

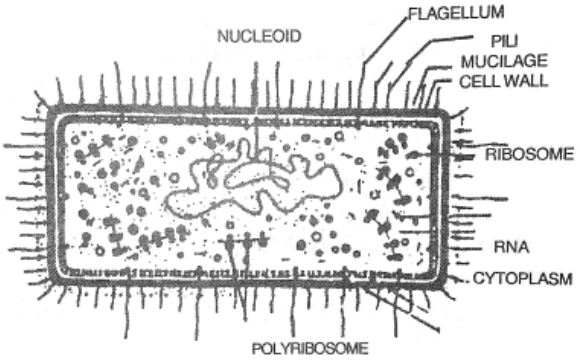

Fig E. coli showing sex pili

148. Give two examples of natural predators of insect-pests.

Ans : **OD 2016**

The beneficial predatory and parasitic insects which depend on these specific insect-pests for food are able to control the pests. For example:

(i) Ladybird beetle and Praying Mantis are useful to get rid of aphids which feed on plant sap.

(ii) Dragonflies control mosquitoes by feeding on its larvae.

LONG ANSWER QUESTIONS

149. How are microbes essential for human welfare?

Ans : **OD 2016**

Microbes are the microscopic, single celled organisms. They cannot seen by naked eyes. Some of these microbes are harmful but plentiful of them are beneficial also. Some important species of microbes are being used in variety of functions in homes, industries, agriculture, sewage treatment etc.

(i) **Use of microbes in formation of Household products** : Lactic Acid Bacteria (LAB) such as **Lactobacillus** is used to form curd from milk. These microbes also improve nutritional quality by increasing vitamin B_{12} content of the curd.

Different varieties of cheese having characteristic texture flavour and taste are produced by using different microbes for partial degradation of milk. eg. swins cheese with large holes in produced by **propionibacterium sharmanii.**

(ii) **Use of microbes in formation of industrial products :** Yeast is used for the production of

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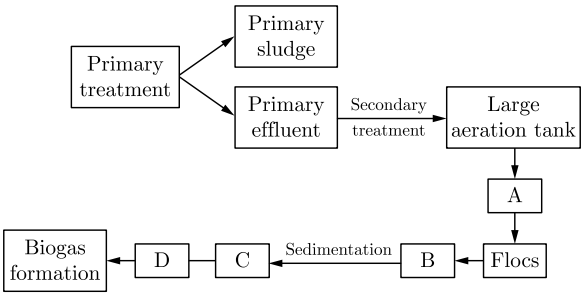
164. Refer to the given below flow chart that shows the sewage treatment.



(i) With reference to the above flow chart explain the role of step A in the given process.

(ii) Identify A, B, C and D in the given process.

(iii) Explain the process at step D.

(iv) What is the significance of low B in the given process and how does it forms C?

Ans :

(i) Step A (mechanical agitation) allows the vigrous growth of useful aerobic microbes into flocs.

(ii) A - Mechanical agitation

B - Reduced BOD

C - Activated sludge

D - Anaerobic sludge digesters.

(iii) At step D, other kinds of bacteria, which grow anaerobically, digest the bacteria and the fungi in the sludge. During this digestion, bacteria produce a mixture of gases such as methane, hydrogen sulphide and carbon dioxide. These gases form biogas and can be used as source of energy as it is inflammable.

(iv) The low BOD level indicates that water is less polluted. Once the BOD of sewage or wastewater is reduced significantly, the effluent is then passed into a settling tank where the bacterial 'flocs' are allowed to sediment. This sediment is called activated sludge.

165. Microbes are also used for commercial and industrial production of certain chemicals like organic acids, alcohols and enzymes. Examples of acid producers are Aspergillus niger (a fungus) of citric acid, Acetobacter aceti (a bacterium) of acetic acid; Clostridium butylicum (a bacterium) of butyric acid and Lactobacillus (a bacterium) of lactic acid. Yeast (Saccharomyces cerevisiae) is used for commercial production of ethanol. Microbes are also used for production of enzymes.

Lipases are used in detergent formulations and are helpful in removing oily stains from the laundry. You must have noticed that bottled fruit juices bought from the market are clearer as compared to those made at home. This is because the bottled juices are clarified by the use of pectinases and proteases.

Streptokinase produced by the bacterium Streptococcus and modified by genetic engineering is used as a 'clot buster' for removing clots from the blood vessels of patients who have undergone myocardial infraction leading to heart attack. Another bioactive molecule, cyclosporin A, that is used as an immunosuppressive agent in organ-transplant patients, is produced by the fungus Trichoderma polysporum. Statins produced by the yeast Monascus purpureus have been commercialised as blood-cholesterol lowering agents. It acts by competitively inhibiting the enzyme responsible for synthesis of cholesterol.

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(i) Which organisms has been Commercialised as blood cholesterol lowering agent?

(ii) Why bottled fruit juices bought from the market are clearer as compared to those made at home?

(iii) Identify a, b, c, d, e and find the given table below

	Organism	**Bioactive Molecule**	**Use**
1.	Monascus purpureus	a	b
2.	c	d	Antibiotic
3.	e	Cyclosporin A	f

(iv) Name the enzyme produced by the bacterium Streptococcus?

Ans :

(i) Statins Produced by the yeast Monascus Purpureus have been commercialised as blood-cholesterol lowering agents.

(ii) Bottled fruit juices bought from the market are clearer because they are clarified by the use of pectinases and Proteases.

(iii) (a) Statin
(b) Cholesterol lowering
(c) Penicillum notatum
(d) Penicillin
(e) Trichoderma polysporum
(f) Immunosuppressive agent

(iv) Streptokinase produced by the bacterium Streptococcus.

1. Ori is a DNA sequence that is responsible for initiating replication. Any piece of DNA when linked to this sequence replicate within the host cells.
2. Ori also controls the copy numbers of the linked DNA.

Thus (a) is correct option.

32. While isolating DNA from bacteria, which of the following enzymes is not used?

(a) Lysozyme (b) Ribonuclease

(c) Deoxyribonuclease (d) Protease

Ans : **OD 2006**

In the process of recombinant DNA technology, the first step is isolation of DNA. Since, the DNA is enclosed within the membranes, we have to break the cell open to release DNA along with other macromolecules such as RNA, proteins, polysaccharides and also lipids.

This can be achieved by treating the bacterial cells plant of animal tissue with enzymes such as lysozyna (bacteria), cellulose (plant cells) and chitinase (fungus).

As we know that genes are located on long molecules of DNA intertwined with proteins such as histones. This RNA can be removed by treatment with ribonuclease, RNA can be removed by treatment with ribonuclease, whereas proteins can be removed by treatment with protease.

Other molecules can be removed by appropriate treatments and purified DNA ultimately precipitates out after the addition of chilled ethanol. Deoxyribonuclease is not used in this process as this enzyme causes the lysis of DNA molecules.

Thus (c) is correct option.

33. Which of the following has popularised the PCR (Polymerase Chain Reaction)?

(a) Easy availability of DNA template

(b) Availability of synthetic primers

(c) Availability of cheap deoxyribonucleotides

(d) Availability of thermostable DNA polymerase

Ans : **DELHI 2016**

The Polymerase Chain Reaction (PCR) is a reaction in which amplification of specific DNA sequences is carried out in vitro. Such repeated amplification is achieved by the use of a thermostable DNA polymerase (isolated from a bacterium, Thermus aquaticus), which remain active and stable during the high temperature and induced denaturation of double-standard DNA.

Thus (d) is correct option.

34. An antibiotic resistance gene in a vector usually helps in the selection of :

(a) Competent cells

(b) Transformed cells

(c) Recombinant cells

(d) Multiple cloning site

Ans : **SQP 2009**

Selectable markers help in identifying and eliminating non-transformants and selectively permitting the growth of the transformants.. The normal E. coli cells do not carry resistance against any of these antibiotics. Competent bacterial cells are made capable to take foreign DNA with chemical treatment, e.g., calcium chloride.

Note : In process of transformation, a piece of DNA is introduced in a host bacterium.

Thus (b) is correct option.

35. Significance of heat shock method in bacterial transformation is to facilitate

(a) Binding of DNA to the cell wall.

(b) Uptake of DNA through membrane transport proteins.

(c) Uptake of DNA through transient pores in the bacterial cell wall.

(d) Expression of antibiotic resistance gene.

Ans : **FOREIGN 2009**

In chemical method, the cell is treated with specific concentration of a divalent cation such as calcium to increase pore size in cell wall. The cells are incubated with recombinant DNA on ice, followed by placing them briefly at 42° C and then putting it back on ice. This is called heat shock method. The bacteria now takes up the recombinant DNA.

Thus (c) is correct option.

36. The role of DNA ligase in the construction of a recombinant DNA molecule is:

(a) Formation of phosphodiester bond between two DNA fragments.

(b) Formation of hydrogen bonds between sticky ends of DNA fragments.

(c) Ligation of all purine and pyrimidine bases.

(d) Formation of hydrogen bonds between blunt ends

Ans : **DELHI 2010**

DNA ligase (joining or selling enzymes) are also called genetic gum. They join two individual fragments of double-stranded DNA by forming phosphodiester bonds between them. Thus they help in sealing gaps in DNA fragments. Therefore, they act as a molecular glue.

Thus (a) is correct option.

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(i) With reference to the above graph, identify the source of different samples A, B, C and D.

(ii) What would happen if D is disposed off in B directly?

(iii) Which among the given samples will contain large number of pathogenic microbes?

(iv) What would be the reason for the higher value of BOD in sample D?

Ans :

(i)

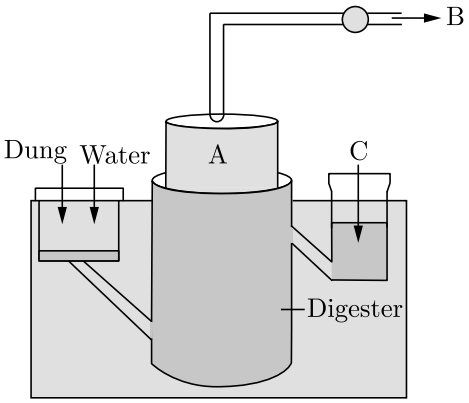
A → Secondary effluent
B → River water
C → Primary effluent
D → Untreated sewage water

(ii) If sample D i.e., untreated sewage water is disposed off in a freshwater body (a river) i.e., sample B then BOD in B will increase and dissolved oxygen will decrease.

(iii) Untreated sewage water (D) contains large amount of microbes, which are pathogenic.

(iv) High value of BOD in sample D is due to high amount of organic wastes and aerobic microbes present in it.

169. Given below is the figure of a bio-gas plant.



(i) Name the group of organisms and the substrate they act on to produce biogas.

(ii) Identify the products A and B and discuss their significance.

(iii) What are methanogens ? How do they generate biogas ?

Ans : **FOREIGN 2014**

(i) The organisms are methanogens which act on cellulosic materials such as cow dung and agricultural waste.

(ii) A is a biogas. It is mixture of gases which consists of methane hydrogen sulphide and carbon dioxide. It can be used a source of energy to nearby houses as it is inflammable. B is the spent slurry or sludge which is removed through another outlet and may be used as a fertilizer.

(iii) Methanogens are methane producing bacteria which grow anaerobically on cellulosic material in cow dung to decompose it to produce large amount of methane, carbon dioxide and hydrogen. This mixture of gas is biogas.

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170. Antibioties term was coined by Waksman. It is derived from the greek word anti-agains and bio-life, together they mean against life. These are the chemical substances that are produced by some microbes that can kill or retard the growth of other disease causing microbes.

(i) The first antibiotic discovered by whom ? Also name the antibiotic.

(ii) Name the mould from which pericillin was produced ?

(iii) Who were awarded nobel prize in 1945 and why ?

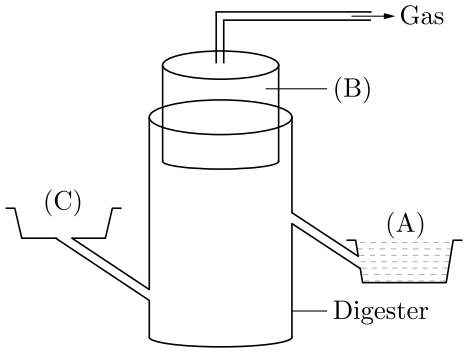
Ans : **OD 2005**

(i) The first antibiotic was pericillin. It was developed by Alexander fleming.

(ii) *Pericillium natatum.*

(iii) Fleming chain and floxey for the potential use of pericillin antibiotic.

166. Biogas generation is done on a large scale in rural India. The given diagram shows a typical biogas plant.



(i) Identify A, B and C.

(ii) Name the bacteria involved in the production of biogas.

(iii) Name the animals in which methanogens occur and the role they play there.

(iv) How biogas is generated from activated sludge?

Ans :

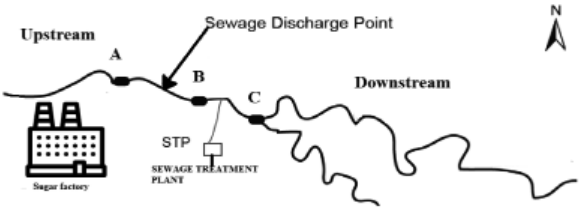
(i) In the given diagram, 'A' represents sludge, 'B' represents gas holder and 'C' represents dung and water.

(ii) Methanogens are used in generation of biogas plant, e.g., Methanococcus, Methanobacterium.

(iii) Methanogens are present in the rumen (a part of stomach of cattle) such as cow, buffalo. In rumen, these bacteria help in the breakdown of cellulose and play an important role in the nutrition of cattle. The excreta of cattle is rich in these bacteria (methanogens) and can be used for generation of biogas.

(iv) A small part of the activated sludge is pumped back into the aeration tank to serve as the inoculum. The remaining major part of the activated sludge is pumped into large tanks called anaerobic sludge digesters. The anaerobic bacteria digest the bacteria and fungi in a sludge and produce mixture of gases like methane, hydrogen sulphide and CO_2 which constitute biogas.

167. Water samples were collected at points A, B and C in a segment of a river near a sugar factory and tested for BOD level. The BOD levels of samples A, B and C were 400 mg/L, 480 mg/L and 8 mg/L respectively.



(i) What is high level of BOD at A and B indicative of?

(ii) Explain why the BOD level gets reduced considerably at the collection point C.

(iii) It was observed that fish mortality was high near point B. Give a suitable reason for this.

(iv) Which part of river is fit for drinking and why?

Ans :

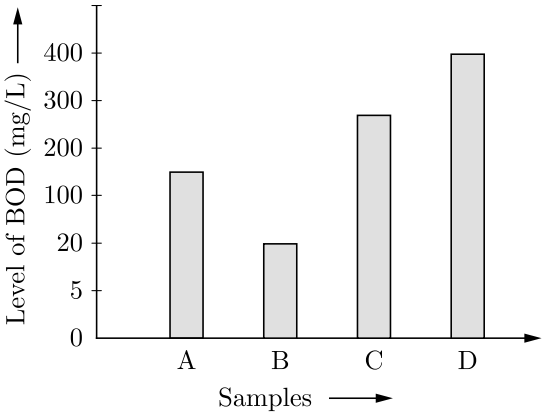
(i) At collection points A and B, the BOD level is 'high due to high organic pollution caused by sugar factory and sewage discharge.

(ii) At the collection point C, the water was released after secondary treatment/ biological treatment where vigorous growth of useful aerobic microbes into flocs consume the major part of the organic matter present in the river water or effluent due to sugar factory and sewage discharge.

(iii) Due to high BOD level, the concentration of dissolved oxygen decreases in the water body which results in high fish mortality.

(iv) The water after point C is fit for drinking because it is a cleaner water released from sewage treatment plant.

168. BOD is a measure of organic matter present in the water. The data below shows the concentration of BOD in different samples obtained from the primary effluent, secondary effluent, untreated sewage and river water.



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7. COMPETENT HOST

Competent host is essential for transformation with recombinant DNA. Bacterial cells must be made capable to take up DNA. Recombinant DNA can then be forced into such cells by incubating the cells with recombinant DNA on ice, followed by placing them briefly at $42^{\circ}C$ (heat shock) and then putting them back on ice. This enables the bacteria to take up the recombinant DNA. In eukaryotic cells, the term **transformation** is replaced by the term **transfection**.

8. VECTORLESS GENE TRANSFER

1. **Methods of Vectorless Gene Transfer :** Different alternative methods have been used to introduce the recombinant DNA into recipient cells of animals without involving carrier molecules.

1 Micro-injection
2. Electroportion
3. Gene Gun or Biolistic Method
4. Chemical Mediated Gene Transfer

9. PROCESSES OF RECOMBINANT DNA TECHNOLOGY

I. Isolation of the Genetic Material (DNA)

In order to cut the DNA with restriction enzymes, it needs to be in pure form, free from other macromolecules.

II. Cutting of DNA at Specific Locations

1. Restriction enzyme digestions are performed by incubating purified DNA molecules by incubating purified DNA molecules with the restriction enzyme, at the optimal conditions for that specific enzyme.
2. Agarose gel electrophoresis is employed to check the progression of a restriction enzyme digestion.
3. '**Gene of interest'** from the source DNA and the cut vector with space are mixed and ligase is added. This resulta in the preparation of recombinant DNA.
4. If required, gene of interest is amplified using PCR.

III. Insertion of Recombinant DNA (rDNA) Into host cell/ organism

The vector DNA (plasmid DNA) and alien (foreign) DNA carrying gene of interest are cut by the same restriction endonuclease to produce complementary sticky ends. With the help of DNA ligase enzyme, the complementary sticky ends of the two DNAs are joined (annealing) to produce a recombinant (chimaera) DNA.

IV. Obtaining the Desirable FOREIGN Gene Product

1. When recombinant DNA is transferred into a bacterial, plant or animal cell, the foreign DNA also multiples. Most of the recombinant technologies are aimed to produce a desirable protein.
2. If any protein encoding gene is expressed in a heterologous host it is known as a "recombinant protein"

10. BIOREACTORS

Bioreactors are considered as vessels in which raw materials are biologically converted into specific products by microbes, plant and animal cells or their enzymes.

11. GEL ELECTROPHORESIS

Electrophoresis is a technique of separation of charged molecules under the influence of an electrical field so that they migrate in the direction of electrode bearing the opposite charge, through a medium/matrix.

12. POLYMERASE CHAIN REACTION (PCR) TECHNIQUE

1. Polymerase chain reaction (PCR) is a technique of synthesising multiple copies of the desired gene (or DNA) in vitro. This technique was developed by Kary Mullis in 1985.
2. It is based on the principle that a DNA molecule, when subjected to high temperature, splits into two strands due to denaturation.

OBJECTIVE QUESTIONS

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1. Which of the following is involved in transcription of tRNA, 5SrRNA and Sn RNA of eukaryotes?
(a) RNA Polymerase I
(b) RNA Polymerase II
(c) RNA Polymerase III
(d) All of these

Ans : **OD 2024, 2021**

The eukaryotic RNA polymerase III transcribe 5 Or RNA, tRNA, Sn RNA or other small stable RNA s involved in RNA Processing.
Thus (c) is correct option.

CHAPTER 9

BIOTECHNOLOGY PRINCIPLES AND PROCESSES

SUMMARY

1. BIOTECHNOLOGY

The definition of biotechnology given by the **European Federation of Biotechnology (EFB)** which covers both traditional views and modern molecular biotechnology is as follows: "Biotechnology is the integrated use of biochemistry, microbiology and engineering sciences in order to achieve technological application of the capabilities of micro-organisms, cultured tissues/cells and parts thereof".

2. PRINCIPLES OF MODERN BIOTECHNOLOGY

The science of biotechnology is manly based on two technologies :

(a) **Genetic Engineering :** It includes techniques to alter the nature of genetic material of host organism by introducing foreign or recombinant DNA into the host organism there by changing their phenotype.

(b) **Chemical Engineering :** It involves maintenance of sterile, microbial contamination free conditions, that allow growth of only the desired micro-organism/ eukaryotic cell in large quantities, for the manufacture of biotechnological products such as antibiotics, vaccines, enzymes, medicines, hormones etc.

3. GENETIC ENGINEERING

1. Genetic engineering is the technology involved in synthesis of artificial genes, repair of genes through fusion, deletion, inversion, shifting of genes, products of recombinant DNA and manipulating them for improvement in human beings, plants, animals and microbes.
2. An important aspect of genetic engineering is recombinant DNA technology. Recombinant DNA from two different organisms to produce recombinant DNA.
3. Tools of Recombination DNA
   (a) Restriction enzyme
   (b) Cloning vector
   (c) Competent Host
   (d) Ligase

4. FUNCTIONING OF RESTRICTION ENZYME

1. Restriction enzymes are present in many bacteria where they function as a part of their defence mechanism called the **Restriction Modification System.** Molecular basis of this system was first explained by **Wemer Arbber in 1965**. The restriction modification system consists of restriction endonucleases and a modification enzyme.
2. Synthesising enzymes, DNA ligases, Alkaline phosphatase are other enzymes used in rDNA technology.

5. CLONING VECTORS (VEHICLE DNA)

1. The vectors are DNA molecules that can carry a foreign DNA segment and replicate inside the host cell.
2. Vectors may be plasmids, bacteriophages, cosmids, Yeast Artificial Chromosomes (YACs), Bacterial Artificial Chromosomes (BACs), transposons and viruses.

6. CHARACTERISTICS OF A CLONING VECTOR

The desirable characteristics of a cloning vector are :

1. **Origin of Replication :** (Ori) is a sequence from where replication starts.
2. **Selectable markers (antibiotic resistance gene) :** are required to identify and eliminate non-transformants and selectively permit the growth of the transformants. Generally, the genes encoding resistance to antibodies such as tetracycline, ampicillin, kanamycin or chloramphenicol, etc. are used as selectable markers for E.coli.

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1. Exonuclease: It removes nucleotides from terminal end of DNA strand.
2. Endonuclease: It cleaves DNA at specific site within the DNA.

Thus (a) is correct option.

12. PCR method is useful for:
(a) DNA
(b) Protein
(c) Amino acid synthesis
(d) DNA amplification

Ans : **OD 2010**

Polymerase chain reaction (PCR) is a molecular biology technique use to amplify specific DNA sequences. It was developed by Kary Mullis.
Thus (d) is correct option.

13. The sticky ends generated by action of EcoRI on insert DNA facilitates action of which enzyme?
(a) DNA polymerase (b) Taq polymerase
(c) Alkaline phosphotase (d) DNA ligase

Ans : **OD 2005**

Calf-intestinal alkaline phosphatase (CIAP/CIP) is a type of alkaline phosphatase that catalyzes the removal of phospahte groups from the 5' end of DNA strands.
Thus (c) is correct option.

14. What is the criterion for DNA fragments movement on agarose gel during gel electrophoresis?
(a) The larger the fragment size, the farther it moves
(b) The smaller the fragment size, the farther it moves
(c) Positively charged fragments move to farther end
(d) Negatively charged fragments do not move

Ans : **DELHI 2010**

The DNA fragments separate according to their sizes through sieving effect provided by the agarose gel. Hence, the smaller the fragment size, the farther it moves.
Thus (b) is correct option.

15. Modern biotechnology is based on
(a) Protoplast fusion
(b) Tissue culture
(c) Recombinant proteins
(d) Genetic engineering

Ans : **DELHI 2018**

The two core techniques that enabled birth of mdern biotechnology are genetic engineering and maintenance of sterile ambience in chemical engineering.
Thus (d) is correct option.

16. Key tools to be involved in recombinant DNA technology are
1. Restriction enzymes
2. Polymerase enzyme
3. Ligase enzyme
4. Vectors

(a) 1 only (b) 1 & 3
(c) 1, 2, 3 only (d) All of these

Ans : **FOREIGN 2015**

The key tools used in recombinant DNA technology are restriction enzymes, ligases, polymerase enzymes, Polymerase Chain Reaction (PCR), competent host and vectors.
Thus (d) is correct option.

17. An ideal cloning vector should have
1. Low molecular weight
2. Origin of replication
3. Desired genes
4. Resistance to antibiotics

(a) 3 and 4 (b) 1, 2, 4
(c) 1 and 3 (d) 2 and 3

Ans : **OD 2005**

The following are the features that are required to facilitate cloning into a vector: origin of replication, selectable marker, cloning sites and low molecular weight of vector.
Thus (b) is correct option.

18. The term "Southern Blotting" refers to
(a) Transfer of DNA fragments from in vitro cellulose membrane to electrophoretic gel
(b) Attachment of probes to DNA fragments
(c) Transfer of DNA fragments from electrophoretic gel to nitrocellulose
(d) Comparison of DNA fragments from two sources.

Ans : **DELHI 2010**

Southern blotting refers to the transfer of electrophoresis-separated DNA fragments to a nitrocellulose or nylon membrane and subsequent fragment detection by probe hybridization.
Thus (c) is correct option.

19. What is true for plasmid?
(a) Plasmids are widely used in gene transfer
(b) These are found in virus
(c) Plasmid contains gene for vital activities
(d) These are main part of chromosome

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Ans : SQP 2019

Plasmid is an autonomously replicating circular extra-chromosomal DNA independent of the control of chromosomal DNA. These plasmid DNA act as vectors to transfer the piece of DNA attached to it. They are widely used in gene transfer.
Thus (a) is correct option.

20. Which of the following statement is incorrect?
(a) Plasmids have the ability to replicate within the bacterial cells independent of the control of chromosomal DNA.
(b) Some plasmids have only one or two copies per cell where as, the other may have 15-100 copies per cell.
(c) Bacteriophages have the ability to replicate within the bacterial cell independent of the control of chromosomal DNA.
(d) Transformation is a procedure of separation and isolation of DNA fragments.

Ans : OD 2005

Transformation is a procedure through which a piece of DNA is introduced in a host bacterium. A technique of separation and isolation of DNA fragment is gel electrophoresis.
Thus (d) is correct option.

21. Read the following statements for restriction enzymes and choose option which have only correct ones.
1. Restriction enzymes belongs to a large class of enzymes called nuclease.
2. Restriction enzymes are of two kinds exonuclease and endonuclease.
3. Restriction enzymes are so called because these only identify particular nucleotide sequence.
4. In nature approximately 900 restriction enzymes are present.

(a) 1, 2 and 3 (b) 1 and 2 only
(c) 1, 3 and 4 (d) 1 and 4 only

Ans : DELHI 2010

Restriction enzymes recognize and bind to specific sequences of DNA, called restriction sites.
Thus (b) is correct option.

22. Which of the following is an advantage of a bioreactor which uses continuous culture system rather than batch culture?
(a) It provides growth conditions like temperature, pH, substrate, salts, vitamins and oxygen
(b) The transformed recombinant cells are allowed to grow in a large bioreactor till maximum amount of biochemicals has been formed.
(c) The bioreactor is made empty, cleaned and a fresh medium is added
(d) There is a regular drainage of the medium and culture cells from one side and fresh medium from the other side leading to higher yield of desired product

Ans : DELHI 2016

Thus (d) is correct option.

23. In agarose gel electrophoresis,
(a) DNA migrates towards negative electrode
(b) Larger molecules migrate faster than smaller molecules
(c) Ethidium bromide can be used to visualize the DNA fragments.
(d) Pink coloured bands of DNA can be visualized when gel exposed to UV light

Ans : SQP 2011

In gel elactro phoresis, ethedium bromide tube visulize the DNA fragments.
Thus (c) is correct option.

24. It is advantageous to use a vector having multiple cloning sites, as it
(a) Contains many copy of cloned genes
(b) Contains many copies of the same restriction enzyme site
(c) Allows flexibility in the choice of restriction enzymes.
(d) Allows flexibility in the choice of genes for cloning.

Ans : FOREIGN 2009

Acloning vector should have multiple cloning sites, it allows flexibility in the choice of restriction enzymes.
Thus (c) is correct option.

25. Which of following feature is not necessary for cloning vector?
(a) Origin of replication
(b) High copy number
(c) Selectable marker
(d) Cloning sites

Ans : COMP 2005

The features that are required to facilitate cloning into a vector are origin of replication, selectable marker and cloning sites. The sequence of ori is also responsible for controlling the copy number of the linked DNA. So, if one wants to recover many copies of the target DNA it should be cloned in a vector whose origin support high copy number.
Thus (b) is correct option.

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26. The transfer of genetic material from one bacterium to another through the mediation of a vector like virus is termed as:

(a) Transduction (b) Conjugation

(c) Transformation (d) Translation

Ans : **OD 2010**

Transduction is the process by which genetic material (DNA) is transferred from one bacterium to another through the mediation of a vector, like virus.

Other option are incorrect because bacterial conjugation is the transfer of genetic material (plasmid) between bacterial cells by direct cell-to cell contact or by a bridge-like connection between two cells.

Transformation is the genetic alteration of a cell resulting from the direct uptake and incorporation of exogenous genetic material (exogenous DNA) from its surroundings and taken up through the cell membranes.

Translation is the process in which cellular ribosomes create proteins. It is a part of the process of gene expression.

Thus (a) is correct option.

27. Which of the given statement is correct in the context of observing DNA separated by agarose gel electrophoresis?

(a) DNA can be seen in visible light

(b) DNA can be seen without staining in visible light

(c) Ethidium bromide stained DNA can be seen in visible light

(d) Ethidium bromide stained DNA can be seen under to UV light

Ans : **OD 2024, DELHI 2020**

The separated DNA fragments (by the process gel electrophoresis) are visualised after staining the DNA with ethidium bromide followed by exposure to UV-radiation. These fragments are seen as orange coloured bands.

Thus (d) is correct option.

28. 'Restriction' in restriction enzyme refers to :

(a) Cleaving of phosphodiester bond in DNA by the enzyme

(b) Cutting of DNA at specific position only

(c) Prevention of the multiplication of bacteriophage in bacteria

(d) All of the above

Ans : **SQP 2012**

The restriction enzymes are called 'molecular scissors' and are responsible for cutting DNA. Restriction enzymes belong to a class of enzymes called nucleases.

They are of two types

1. **Exonucleases :** Cut DNA at the ends
2. **Endonucleases :** Make cuts at specific positions within the DNA.

These enzymes are present in bacteria to provide a type of defence mechanism called the 'restriction modification system'.

This system consist of two components, restriction enzyme and modification enzyme. The term 'restriction' refer to the function of these enzyme in restricting the propagation of foreign DNA of bacterophange in host bacterium, i.e., cutting of DNA at specific position only.

Thus (b) is correct option.

29. Which of the following is not required in the preparation of a recombinant DNA molecules?

(a) Restriction endonucleases

(b) DNA ligase

(c) DNA fragments

(d) *E*. coli

Ans : **OD 2024, SQP 2015**

Restriction enzymes and DNA ligases can be used to make a stable recombinant DNA molecule, with DNA fragments that has been spliced together from two different organisms.

Thus (d) is correct option.

30. In agarose gel electrophoresis, DNA molecules are separated on the basis of their :

(a) Charge only (b) Size only

(c) Charge to size ratio (d) All of these

Ans : **FOREIGN 2020**

In agarose gel electrophoresis, the DNA fragments separate out (resolve) according to their size or length because of the sieving property of agarose gel. It means the smaller the fragment size, the farther it will move.

Thus (b) is correct option.

31. The most important feature in a plasmid to be used as a vector is:

(a) Origin of replication

(b) Presence of a selectable marker

(c) Presence of sites for restriction endonuclease

(d) Its size

Ans : **COMP 2005**

All of the given features are important to facilitate cloning into a vector but out of them, origin of replication is the most important one.

This is due to the following reasons :

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2. The specific sequence of DNA recognized by Restriction Endonuclease are:
(a) Palindromic nucleotide sequence
(b) VNTR
(c) Minisatellite
(d) All of these

Ans : OD 2018
Restriction Endonuclease enzymes recognise a specific DNA sequence reffered to as, palin dromic nucleotide sequence. Such DNA sequence are same whether read from 5' to 3' on one stand Or 5' to 3' on the complementary strand. eg. restriction site for ECORI is 5-GAATTC-3'.
Thus (a) is correct option.

3. GAATTC is recognition site for which restriction endonuclease?
(a) Hind III (b) Eco RI
(c) Bam I (d) Hae III

Ans : OD 2018
GAATTC is a recognition site for Eco RI endonuclease enzyme. Here, this enzyme cleaves the sequence between guanine and Adenine nitrogenous bases ($-$ G AATTC $-$) and produce sticky ends.
Thus (b) is correct option.

4. A molecular technique which multiple copy of the desired gene is synthesized in vitro is called as:
(a) ELISA (b) PCR
(c) Gel Electrophoresis (d) Flow cytometry

Ans : OD 2018
Polymerase Chain Reaction (PCR) is a technique of making multiple copies of a specific DNA sequence or gene in vitro. This technique was discovered by Karry Mullis in 1983
Thus (b) is correct option.

5. Which of the following enzyme is used to break the bacterial cell wall to release DNA and other bio-macromolecules?
(a) Lysozyme (b) Cellulase
(c) Chitinase (d) Collagenase

Ans : OD 2018
Lysozyme is a glycoside hydrolase that catalyzes the hydrolysis of 1, 4-beta-linkages between *N* -acetylmuramic acid and *N*-acetly-D-Glucosamine residues in peptidoglycan, which is the major component of gram positive bacterial cell wall.
Thus (a) is correct option.

6. Bacteria has:
(a) plasmid DNA (b) RNA
(c) both a and b (d) none of these

Ans : COMP 2009
Explanation- Bacteria possess both plasmid DNA as well as RNA.
Thus (c) is correct option.

7. Sources of Eco of RI enzyme is
(a) Bam HI (b) E. coli
(c) both (a) and (b) (d) Hind III

Ans : OD 2015
Eco RI is a restriction endonudease enzyme isolated from E. coli bacteria. This enzyme cleaves DNA double helices into fragments at specific sites.
Thus (d) is correct option.

8. Ti-plasmid is found in
(a) Agrobacterium tumifaciens
(b) E. coli
(c) B. coli
(d) all of these

Ans : OD 2015
Tumor inducing plasmid (or Ti-plasmid) is found in Agrobacterium tumifaciens. It is called the natural genetic engineer. It cause crown gall disease in plants.
Thus (a) is correct option.

9. Agarose is extracted from
(a) sea weeds (b) maize
(c) cycas (d) none of these

Ans : OD 2015
Agarose is a polysaccharide, which is obtained from red seaweed such as gracilaria and gelidium. It is widely used in genetic engineering.
Thus (a) is correct option.

10. PCR is used to detect:
(a) HIV (b) Cancer
(c) TB (d) Cholera

Ans : OD 2012
Polymerase chain reaction (PCR) is a technique used to exponentially amplify a specific target DNA sequence, allowing for the isolation, sequencing, or cloning of a single sequence among many. It is used in diagnosis of AIDS.
Thus (b) is correct option.

11. Restriction enzymes are:
(a) Exonuclease (b) Endonuclease
(c) Ligase (d) Polymerase

Ans : OD 2012
Restriction enzymes are enzymes used for cutting DNA at specific sites. There are two types of restriction enzymes.

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37. Which of the following is not a source of restriction endonuclease?
(a) Haemophilus influenzae
(b) Escherichia coil
(c) Agrobacterium tumefaciens
(d) Bacillus amylase

Ans : **COMP 2005**

Agrobacterium tumefaciens is a pathogen of several dicot plants. It delivers a piece of DNA known as 'T-DNA' in the Ti plasmid which transforms normal plant cells into tumour cells to produce chemicals aganinst pathogens.

The restriction enzyme EcoRI, is isolated from Escherichia coli RY13.

The first restriction enzymes Hind II was isolated from bacterium Haemophilus influenzae.
Thus (c) is correct option.

38. Which of the following steps are catalysed by Taq polymerase in a PCR reaction?
(a) Denaturation of template DNA
(b) Annealing of primers to template DNA
(c) Extension of primer end on the template DNA
(d) All of the above

Ans : **OD 2007**

In polymerase chain reaction, polymerisation or extension step is catalysed by Taq polymerase enzyme. PCR is carried out in the following three steps :

1. **Denaturation :** The double-stranded DNA is denatured by applying high temperature of 95° C for 15 seconds, each separated single-stranded strand now acts as template for DNA synthesis.
2. **Annealing :** Two sets of primers are added which anneal to the 3' end of each separated strand. Primers act as initiators of replication.
3. **Extension :** DNA polymerase extends the primers by adding nucleotides complementary to the template provided in the reaction.

A thermostable DNA polymerase (Taq DNA polymerase) is used in the reaction which can tolerate the high temperature of the reaction.

All these steps are repeated many times to obtain several copies of desired DNA.
Thus (c) is correct option.

39. A bacterial cell was transformed with a recombinant DNA that was generated using a human gene. However, the transformed cells did not produce the desired protein. Reasons could be:
(a) Human gene may have intron which bacteria cannot process
(b) Amino acid condons for humans and bacteria are different
(c) Human protein is formed but degraded by bacteria
(d) All of the above

Ans : **SQP 2005**

The process of making recombinant DNA molecule involves the introduction of a desired gene into the DNA of a host that will produce the desired protein.

Indiucing a cloned eukaryotic gene to function in a prokaryotic host can be difficult sometime. The presence of long non-conding introns in eukaryotic genes may prevent correct expression of these genes in prokaryotes, which lack RNA-splicing machinery.
Thus (a) is correct option.

40. Which of the following should be choosen for best yield if one were to produce a recombinant protein in large amounts?
(a) Laboratory flask of largest capacity
(b) A stirred-tank bioreactor without in-lets and out-lets and out-lets
(c) A continuous culture system
(d) Any of the above

Ans : **COMP 2008**

If any protein encoding gene is expressed in a heterologous host, it is called a recombinant protein. The cells harbouring cloned genes of interest may be grown on a small scale in the laboratory.

The cultures may be used for extracting the desired protein and then purifying it by using different separation techniques.

The cells can also be multiplied in a continuous culture system wherein the used medium is drained out from one side while fresh medium is added from the other to maintain the cells in their physiologically most active log/ exponential phase. This type of culturing method produces a larger biomass leading to higher yields of desired protein.
Thus (c) is correct option.

41. Which of the following statements does not hold true for restriction enzyme?
(a) It recognizes a palindromic nucleotide sequence.
(b) It is an endonuclease.

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Ans : SQP 2010

Plasmid is a small fragment of DNA (about 10 Kbp size) that is physically separate form and can replicate freely of chromosomal DNA within a cell. It can clone small DNA fragments.
Cosmid - 45 Kbp
BAC - 300-350 Kbp
YAC - 1 Mbp/1000-2500 Kbp
Thus (a) is correct option.

55. The recognition sequence of restriction enzyme **A** is GGCC and that of **B** is GAATTC. Which statement among the following is true regarding the probable frequency of cutting sides in a genome.
(a) Both A and B cut equally frequently
(b) A cuts once every 676 nucleotides and B 1024 nucleotides
(c) A cuts once every 256 nucleotides and B 4096 nucleotides
(d) A cuts once every 256 nucleotides and B 1024 nucleotides

Ans : FOREIGN 2013

There are four nucleotides, i.e. A, T, G and C. In case of A enzyme, it is four nucleotides sequence cutter. Therefore, the probable frequency of fragments produced by A is $4^4 = 256$ nucleotides. Similarly, with B enzyme, the number of fragments produced by it is $4^6 = 1024$ nucleotides.

Thus, A cut (s) at every 256 nucleotides and B produces cut at 1024 nucleotides in sequence.
Thus (d) is correct option.

56. An analysis of chromosomal DNA using the Southern hybridisation technique does not use
(a) electrophoresis (b) blotting
(c) autoradiography (d) PCR

Ans : COMP 2006

Southern hybridisation is a technique used in molecular biology for detection of a specific DNA sequence in DNA samples. Except PCR, we use all three methods such as electrophoresis, blotting and autoradiography.

PCR is a method used for the amplification of DNA sample. In vitro clonal propagation is characterised by PCR and RAPD.
Thus (d) is correct option.

57. Commonly used vectors for human genome sequencing are
(a) T-DNA
(b) BAC and YAC
(c) Expression vectors
(d) T/A cloning vectors

Ans : OD 2006

Commonly used vectors for human genome sequencing are BAC and YAC. BAC is a DNA construct, based on a functional fertility plasmid (F-plasmid) used for transforming and cloning in bacteria (E. coli) and YAC are genetically engineered chromosomes derived from the DNA of the yeast, Saccharomyces cerevisiae which is then ligated into a bacterial plasma.
Thus (b) is correct option.

58. The first recombinant DNA was constructed by linking an antibiotic resistant gene with the native plasmid of
(a) Escherichia coli
(b) Salmonella typhimurium
(c) clostridium butylicum
(d) Acetobacter aceti

Ans : DELHI 2008

The construction of first recombinant DNA emerged from the linking of gene encoding antibiotic resistance gene with a native plasmid of salmonella typhimurium.

It was accomplished by Stanley Cohen and Herbert Boyer in 1972. They isolated the antibiotic resistance gene by cutting out a piece of DNA. This cutting of DNA specific locations is carried out by molecular scissors also known as restriction enzymes.
Thus (b) is correct option.

59. Bioreactors are useful in
(a) separation and purification of a product
(b) processing of large volumes of culture
(c) micro-injection
(d) isolation of genetic material

Ans : COMP 2015

Biorecators are the large volume vessels in which raw materials are biologically converted into specific products, individual enzymes, etc. using microbial, plant, animal or human cells. It provides the optimal conditions for achieving the desired product by providing optimum growth conditions like pH, temperature, substrate, salt, vitamins and oxygen.
Thus (b) is correct option.

60. Some foreign DNA fragment is attached to Cla I site of pBR322. This recombinant vector is used to transit Escherichia coli host cells. The cells subjected to transformation are palted on two different media-one containing ampicillin and the other containing tetracycline. The transformed

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(a) Salmonella typhimurium
(b) Rhizopus nigricans
(c) Retrovirus
(d) Baculovirus

Ans : **FOREIGN 2009**

Retrovirus has been disarmed and is now used to deliver desirable genes into animal cells.
Thus (c) is correct option.

48. Which can be used as vector for transfer of DNA segment?
1. Bacterium
2. Plasmid
3. Plasmodium
4. Bacteriophage

(a) 1, 2 and 4 (b) 1 only
(c) 1 and 3 (d) 2 and 4

Ans : **COMP 2014**

Both plasmid and bacteriophage can act as vector.
Thus (d) is correct option.

49. Stirred-tank bioreactors have been designed for
(a) purification of product
(b) addition of preservatives to the product
(c) availability of oxygen throughout the process
(d) ensuring anaerobic conditions in the culture vessel

Ans : **OD 2015**

A stirred-tank bioreactor is usually cylindrical, possessing stirrer which facilitates mixing of the reactor contents and oxygen availability through out the bioreactor. The bioreactor has an agitator system, an oxygen delivery system, foam control, pH and temperature contral systems. Hence, options (c) is correct.
Thus (c) is correct option.

50. A foreign DNA and plasmid cut by the same restriction endonuclease can be joined to form a recombinant plasmid using
(a) Eco RI (b) taq polymerase
(c) polymerase III (d) ligase

Ans : **DELHI 2005**

DNA ligases (genetic gum) are used in recombinant DNA technology to join two individual fragments of double-stranded DNA by forming phosphodiester bonds between them to produce a recombinant DNA (plasmid).
Thus (d) is correct option.

51. Which of the following is not a component of downstream processing?
(a) Separation (b) Purification
(c) Preservation (d) Expression

Ans : **COMP 2010**

Downstream processing is the process of separation and purification of products synthesised in bioreactors. After the completion of biosynthetic stage, the product has to be subjected through a series of processes before it is ready for marketing as a finished product.

The processes separation and purification, collectively referred to as downstream processing. The product is then formulated with suitable preservatives. Hence, option (d) is incorrect and all other options are correct.
Thus (d) is correct option.

52. Restriction endonucleases are
(a) used for in vitro DNA synthesis
(b) synthesised by bacteria as part of their defense mechanism
(c) present in mammalian cells for degradation of DNA when the cells dies
(d) used in genetic engineering for ligating two DNA molecules

Ans : **OD 2006**

Restriction endonucleases are synthesised by bacteria as part of their defence mechanism. It is an enzyme that cuts DNA at or near specific recognition nucleotide sequences known as restriction sites. These enzymes are found in bacteria to provide a defence mechanism against viruses by cleaning the toxic viral DNA
Thus (d) is correct option.

53. The function of a selectable marker is
(a) eliminating transformants and permitting non-trnasformants
(b) identify ori site
(c) elimination of non-transformants and permitting transformants
(d) to destroy recognition sites

Ans : **DELHI 2008**

Elimination of non-transformants and permitting transformants.
Selectable marker are used for the identification of transformant cell. It selectively permits the growth of the transformants.
Thus (c) is correct option.

54. Which vector can clone a small fragment of DNA?
(a) Plasmid
(b) Bacterial artificial chromosome
(c) Cosmid
(d) Yeast artificial chromosome

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(b) are small circular DNA molecules which their own replication origin site

(c) can shuttle between prokaryotic and eukaryotic cells

(d) often carry antibiotic resistance genes

Ans : SQP 2011

Plasmids replicate autonomously. These carry a signal situated at their replication origin, which determines how many copies are to be made and this number can be artificially increased for cloning a given gene.
Thus (b) is correct option.

ASSERTION AND REASON

DIRECTION : Each of these questions contains as Assertion following by Reason. Read them carefully and answer the question on the basis of following options. You have to select the one that best describes the two statements.

82. Assertion : Plasmids are extra chromosomal DNA.
Reason : Plasmids are found in bacteria and are useful in genetic engineering.

(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) The Assertion is correct but Reason is incorrect.

(d) Both the Assertion and Reason are incorrect.

Ans : OD 2005

Plasmids are the extra-chromosomal part in the bacteria and are useful in recombinant DNA technology.
Thus (b) is correct option.

83. Assertion : Plasmids are single-stranded extra chromosomal DNA.
Reason : Plasmids are usually present in eukaryotic cells.

(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) The Assertion is correct but Reason is incorrect.

(d) Both the Assertion and Reason are incorrect.

Ans : DELHI 2007

Plasmid is a extra chromosomal DNA present in prokaryotes e.g., bacteria.
Thus (c) is correct option.

84. Assertion : Clones are produced by sexual reproduction.
Reason : These are prepared by group of cells descended from many cells or by inbreeding of a heterozygous line.

(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) The Assertion is correct but Reason is incorrect.

(d) Both the Assertion and Reason are incorrect.

Ans : SQP 2016

Cloning is shortcut method to amplify the number of organisms with a desirable constitution. No sex in involved in their production. Members of clone are genetically identical as they are derived from single parent.
Thus (d) is correct option.

85. Assertion : In recombinant DNA technology human genes are often transferred into bacteria (prokaryotes) or yeast (eukaryote).
Reason : Both bacteria and yeast multiply very fast to form huge population which expresses the desired gene.

(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) The Assertion is correct but Reason is incorrect.

(d) Both the Assertion and Reason are incorrect.

Ans : OD 2011

In recombinant DNA technology, recombinants DNA are usually transferred to E. coli, yeast because of their rapid multiplication. This technology is employed for combining DNA from two different organisms to produce recombinant DNA.
Thus (a) is correct option.

86. Assertion : Agrobacterium tumefaciens is popular in genetic engineering because this bacterium is associated with the roots of all cereal and pulse crops.
Reason : A gene incorporated in the bacterial chromosomal genome-gets automatically

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cells containing the recombinant vector
(a) will grown on both tetracycline containing and ampicillin containing media
(b) will not grow on either tetracycline containing or ampicillin containing media
(c) will grow on tetracycline, but not on ampicillin containing medium
(d) will grow on ampicillin, but not on tetracycline containing medium

Ans : **SQP 2005**

The transformed cells will grow on ampicillin but not on teracyclie. This is because the foreign DNA fragment is attached to cla I site, which is present in the region of tet^R gene. Thus, it cause disintegration of tet^R gene.
Thus (d) is correct option.

61. During gene cloning which is called as 'gene taxi'?
(a) Vaccine
(b) Plasmid
(c) Bacterium
(d) Protozoa

Ans : **OD 2005**

Plasmids are considered as vectors. The vectors are DNA molecules that can carry a foreign DNA segment and replicate inside the host cell. That's why during gene cloning plasmid is called as gene taxi.
Thus (b) is correct option.

62. Minisatellites or VNTRs are used in
(a) DNA fingerprinting
(b) Polymerase Chain Reaction (PCR)
(c) gene therapy
(d) gene mapping

Ans : **FOREIGN 2008**

Minisatellites or Variable Number of Tandem Repeats (VNTRs) is used in DNA fingerprinting technique. In VNTR, satellite DNA as probe is used that shows very high degree of polymorphism. The technique used Southern blot hybridisation using radiolabelled VNTR as a probe.
Thus (a) is correct option.

63. Which of the following option is correct for recombinant DNA technology?
(a) Endonuclease enzyme removes nucleotides from the ends of DNA
(b) Exonuclease enzyme removes nucleotides from site within DNA
(c) Endonuclease enzyme cut long polandric DNA strand
(d) Exonuclease enzyme removes nucleotides from ends of DNA

Ans : **DELHI 2019**

The most correct and appropriate option is that exonuclease removes nucleotides from the terminal ends of DNA and cut a short palindromic DNA strand. Endonuclease remove nucleotides from specific positions within the DNA.
Thus (d) is correct option.

64. The colonies of recombinant bacteria appear white in contrast to blue colonies of non-recombinant bacteria because of
(a) Insertional inactivation of α-galactosidase in non-recombinant bacteria
(b) insertional inactivation of β-galactosidase in recombinant becteria
(c) inactivation of glycosidase enzyme in bacteria
(d) non-recombinant bacteria containing β -galactosidase

Ans : **SQP 2017**

The colonies of recombinant bacteria appear white in contrast to blue colonies of non-reconbinant bacteria due to inactivation of beta-galactosidase enzyme in recombinant bacteria.
Thus (b) is correct option.

65. DNA fragments generated by the restriction endonucleases in a chemical reaction can be separated by
(a) polymerase chain reaction
(b) electrophoresis
(c) restriction mapping
(d) centrifugation

Ans : **FOREIGN 2009**

Electrophoresis is used to separate different pieces of DNA on the basis of their size, shape, surface area and molecular weight. Restriction fragments can easily be separated using this technique.
Thus (b) is correct option.

66. For transformation, micro-particles coated with DNA to be bombarded with gene gun are made up of
(a) silver or platinum (b) platinum or zinc
(c) silicon or platinum (d) gold or tungsten

Ans : **COMP 2011**

Biolistics or gene gun is a direct or vectorless way used to introduce alien DNA into host cells. In this method of gene transfer, high velocity micro particles of gold or tungsten, coated with DNA are bombarded on the plant cells.
Thus (d) is correct option.

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67. PCR and Restriction Fragment Length Polymorphism are the methods for
(a) Study of enzymes
(b) genetic transformation
(c) DNA sequencing
(d) genetic fingerprinting

Ans : **OD 2019**

Polymerase Chain Reaction (PCR) and Restriction Fragment Length Polymorphism (RELP) are used in genetic fingerprinting. RELP identifies the length polymorphism of genes among individuals and PCR is used to amplify that particular DNA fragment (gene).
Thus (c) is correct option.

68. Which one is a true statement regrading DNA polymerase used in PCR?
(a) It is used to ligate introduction DNA in recipient cells
(b) It serves as a selectable marker
(c) It is isolated from a virus
(d) It remains active at high temperature

Ans : **DELHI 2005**

PCR is used to amplify a DNA segment or to synthesise in vitro the multiple copies of gene (DNA) of interest, using two sets of primers and the enzyme DNA polymerase. This enzyme is isolated from a bacterium Thermus aquaticus and it remains active during the high temperature, but high temperature induces denaturation of double-stranded DNA.
Thus (d) is correct option.

69. The source of taq polymerase used in PCR is a
(a) thermophilic fungus
(b) mesophilic fungus
(c) thermophilic bacterium
(d) halophilic bacterium

Ans : **SQP 2010**

The enzyme taq polymerase used in PCR is isolated from a thermophilic bacteria called Thermus aquaticus.
Thus (c) is correct option.

70. There is a restriction endonuclease called Eco RI. What does 'co' part in it stand for?
(a) Coelom (b) Coenzyme
(c) coli (d) Colon

Ans : **COMP 2020**

Restriction endonuclease recognises a particular palindromic sequence and degrades the same. It was so, called because it restricted the growth of bacteriophage in the bacterium (e.g. E. coli).

The convention for naming these enzymes is the first latter of the name comes from the bacterial genus; the second two letters come from the species, and the fourth letter from strain, e.g. Eco RI comes from Escherichia coli RY13. Roman numbers following the names indicate the order in which the enzymes were isolated.
Thus (c) is correct option.

71. A clone is a
(a) heterozygote obtained asexually
(b) homozygote obtained asexually
(c) heterozygote produced by sexual methods
(d) homozygote produced by sexual reproduction

Ans : **FOREIGN 2020**

Clone is a homozygote obtained asexually or it is a group of individuals or cells derived from single parent or cell through asexual reproduction. All the cells in a clone have the same genetic material and are exact copies of the original.
Thus (b) is correct option.

72. Gene amplification using primers can be done by
(a) microinjection
(b) ELISA
(c) polymerase chain reaction
(d) gene gun

Ans : **OD 2024, 2005**

Gene amplification using primers can be done by PCR. In this reaction, multiple copies of the gene of interest is synthesised in vitro using two sets of primers and the enzymes DNA polymerase. Primers are small chemically synthesised oligonucleotides that are complementary to the regions of DNA.
Thus (c) is correct option.

73. Which of the following statements is not true for a clone?
(a) Clones are descended from a single parent
(b) Identical twins are not clones
(c) Clone is a result of sexual reproduction
(d) Both (a) and (c)

Ans : **DELHI 2006**

A clone consists of asexual progeny of a single individual or cell. The process of producing a clone is called cloning. As the individual of a clone have the same genotype, which is also identical with that of the individual from which the clone was derived.
Thus (c) is correct option.

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74. A kind of biotechnology involving manipulation of DNA is
(a) DNA replication
(b) genetic engineering
(c) denaturation
(d) renaturation

Ans : SQP 2020

In genetic engineering rDNA technology is applied to several biotechnological processes for obtaining particular biochemical improvement of genetic make up of an organism and fighting genetic defects.
Thus (b) is correct option.

75. Which of the following is correctly matched?
(a) Agribacterium tumefaciens - Tumour
(b) Thermus aquaticus - Bt gene
(c) pBR322 - Enzyme
(d) Ligase - Molecular scissors

Ans : COMP 2008

Agrobacterium tumefaciens (updated scientific name: Rhizobium ra radiobacter) is the causal agent of crown gall desease (the formation of tumour) in over 140 species of It is a rod-shaped, Gram negative soil bacterium (smith, et. at 1970). Symptoms are caused by the insertion of a small segment of DNA, known as T-DNA (transfer DNA) into the plant cell, which is incorporated at a semi-random location into the plant genome.
Thus (a) is correct option.

76. What is true for plasmid?
(a) Found in viruses
(b) Contains genes for vital activities
(c) Part of nuclear chromosome
(d) Widely used in gene transfer

Ans : FOREIGN 2007

Plasmid is an extra chromosomal genetic element of DNA that is capable of replicating independently of host chromosome. It forms the basis of many cloning vectors used in genetic engineering.
Thus (d) is correct option.

77. A suitable vector for gene cloning in higher organisms is
(a) adenovirus
(b) retrovirus
(c) Salmonella typhimurium
(d) Neurospora crassa

Ans : OD 2009

Vector is a DNA molecule that has the ability to replicate autonomously in an appropriate host cell and into which the DNA fragment to be cloned is integrated for cloning. In higher organism retroviruses vectors are used, while Baculovirus vectors are used for production of transgenic proteins in silkworm.
Thus (b) is correct option.

78. Which of the following radioisotope is not suitable for DNA labelling based studies?
(a) H^3 (b) P^{32}
(c) N^{15} (d) S^{35}

Ans : DELHI 2005

S^{35} radioisotope is not suitable for DNA labelling based studies as DNA does not contain sulphur. S^{35} radioisotope is suitable for protein labelling based studies because protein contains sulphur.
Thus (d) is correct option.

79. PCR proceeds in three distinct steps governed by temperature, they are in order of
(a) de-naturation, annealing, synthesis
(b) synthesis, annealing, denaturation
(c) annealing, synthesis, denaturation
(d) denaturation, synthesis, annealing

Ans : COMP 2015

PCR was developed by Kary Mullis. It is composed of denaturation of DNA at high temperature, annealing of primers at the ends of DNA strands and synthesis/polymerisation by polymerase.
Thus (a) is correct option.

80. Blood stains are found at the site of a murder. If DNA profiling technique is to be used for identifying the criminal, which of the following ideal for use?
(a) Serum (b) Erythrocytes
(c) Leucocytes (d) Platelets

Ans : FOREIGN 2020

DNA fingerprinting is a technique to identify a person on the basis of person's DNA specificity. The technique is based upon the fact that the DNA constitution of an individual carries some specific sequences of nucleotides, which do not carry an information for protein synthesis.

From the given options, leucocytes are to be used for identifying the criminal because they are nucleated, whereas erythrocytes are enucleated.
Thus (c) is correct option.

81. Plasmids are suitable vectors for gene cloning because these
(a) are small circular DNA molecules, which can integrate with host chromosomal DNA

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(c) It is isolated from viruses.

(d) It produces the same kind of sticky ends in different DNA molecules.

Ans : **FOREIGN 2011**

The restriction enzymes are called 'molecular scissors' and are responsible for cutting DNA on specific sites. These are not found in viruses.

They are present in bacteria to provide a type of defense mechanism called the restriction modification system and the so called system consist of two components; restriction enzymes and modification enzyme.

The first component include restriction endonuclease, which identify the introduced foreign DNA and cut it into process. Same kind of sticky end in different individual molecule of DNA are also produced by these molecular scissors. Special sequence in the DNA recognized by restriction endonuclease is called palindromic nucleotide sequence.

Thus (c) is correct option.

42. pBR-322 which is frequently used as a vector for cloning gene is-

(a) An original bacterial plasmid

(b) A modified bacterial plasmid

(c) A viral genome

(d) A transposon

Ans : **DELHI 2005**

pBR-322 is an E.coli cloning vector. It was modified to improve the properties for the cloning, recovery, and sequencing of blunt-ended DNA fragments.

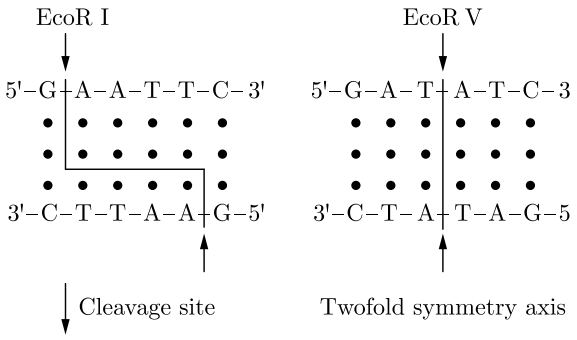
Thus (b) is correct option.

43. Which of the following restriction enzymes produces blunt ends?

(a) Xho I (b) Hind III

(c) Sal I (d) Eco RV

Ans : **OD 2007**



Thus (d) is correct option.

44. Stirred-tank bioreactors have been designed for :

(a) Availability of oxygen throughout the process

(b) Ensuring anaerobic conditions in the culture vessel

(c) Purification of product

(d) Addition of preservatives to the product

Ans : **SQP 2012**

A bioreactor provides the optimal conditions for achieving the desired product by providing optimum growth conditions (temperature, pH, substrate, salts, vitamins, oxygen). The stirrer facilitates even mixing and oxygen availability throughout the bioreactor. The most commonly used bioreactors are of stirring type.

Thus (a) is correct option.

45. Which one of the following represents a palindromic sequence in DNA?

(a) 5'-GAATTC-3'
3'-CTTAAG-5'

(b) 5'-CCAATG-3'
3'-CAATCC-5'

(c) 5'-CATTAG-3'
3'-GATAAC-5'

(d) 5'-GATACC-3'
3-CCTAAG-5'

Ans : **FOREIGN 2013**

3'-CTTAAG-5'
5'-GAATTC-3'
3'-CTTAAG-5'

These sequences read the same on the two strand in $5' \rightarrow 3'$ direction. This is also true in the 3'-5' direction.

Thus (a) is correct option.

46. There is a restriction endonuclease called EcoRI. What does "co" part in it stand for?

(a) Coli (b) Colon

(c) Coelom (d) Coenzyme

Ans : **SQP 2005**

The first letter of the name comes from the genes and the second tow letters come from the species of the prokaryotic cell from which they were isolated.

In EcoRI, the letter R is derived from the name of strain. Roman numbers following the names indicate the order in which the enzymes were isolated from that strain of bacteria.

Thus (a) is correct option.

47. Which one of the following is used as vector for cloning into higher organisms?

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transferred to the crop with which the bacterium is associated.

(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) The Assertion is correct but Reason is incorrect.

(d) Both the Assertion and Reason are incorrect.

Ans : **FOREIGN 2006**

A soil inhabiting, plant pathogenic bacteria Agrobacterium tumefaciens infects broad leaved crops including tomato, soyabean, sunflower and cotton but not the cereals. Tumour formation (crown galls) is induced by its plasmid (Ti) into the chromosomal DNA of its host plant. The T-DNA causes tumors. As gene transfer occurs without human efforts the bacteria is known as natural genetic engineer of plants.
Thus (d) is correct option.

87. **Assertion :** Restriction enzymes cut the strand of DNA to produce sticky ends.
Reason : Stickiness of the ends facilitates the action of the enzyme DNA polymerase.

(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) The Assertion is correct but Reason is incorrect.

(d) Both the Assertion and Reason are incorrect.

Ans : **COMP 2005**

Restriction enzymes, a type of endonuclease, functions by "inspecting" the length of a DNA sequence. Once it finds a recognition sequence, it binds and cut each of the two strands of the double helix at specific point leaving single stranded portions at the ends. This results in overhanging stretches called sticky ends. These are named so because they form hydrogen bonds with their complementary counter parts i.e., they can join similar complementary ends of DNA fragment from some other source with the help of DNA ligase. This stickness of the ends facilitates the action of the enzyme DNA ligase, not DNA polymerase.
Thus (c) is correct option.

88. **Assertion :** "DNA finger printing" has become a powerful tool to establish paternity and identity of criminals in rape and assault cases.
Reason : Trace evidences such as hairs, saliva and dried semen are adequate for DNA analysis.

(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) The Assertion is correct but Reason is incorrect.

(d) Both the Assertion and Reason are incorrect.

Ans : **DELHI 2016**

DNA finger printing has become a powerful tool due to its ability in tracing evidences of crime and to establish the paternity. These evidences can be collected from hairs, semen and saliva.
Thus (a) is correct option.

89. **Assertion :** In recombinant DNA technology, human genes are often transferred into bacteria (prokaryotes) or yeast (eukaryote).
Reason : Both bacteria and yeast multiply very fast to form huge population, which express the desired gene.

(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) The Assertion is correct but Reason is incorrect.

(d) Both the Assertion and Reason are incorrect.

Ans : **SQP 2011**

Recombinant DNA is a form of synthetic DNA that is engineered through the combination or insertion of one or more DNA strands, thereby combining DNA sequences that would not normally occur together. In terms of genetic modification, recombinant DNA is produced through the addition of relevant DNA into an existing organismal genome, such as the plasmid of bacteria, to code for or alter different traits for a specific purpose, such as immunity. If differs from genetic recombination, in that it does not occur through processes within the cell or ribosome, but is exclusively engineered. Recombinant protein is protein that is derived from recombinant DNA.
Thus (a) is correct option.

NODIA

90. **Assertion :** Insertion of recombinant DNA within the coding the coding sequence of β-galactosidase results in colourless colonies.
Reason : Presence of insert results in inactivation of enzyme β-galactosidase known as insertional

inactivation.

(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) The Assertion is correct but Reason is incorrect.

(d) Both the Assertion and Reason are incorrect.

Ans : . **COMP 2018**

Alternative markers have been developed that can differentiate recombinants from non-recombinants based upon their ability to produce colour in presence of a chromogenic substrate. The plasmid in the bacteria, lacking an insert produces blue coloured colonies, while those plasmids with an insert do not produce any colour due to insertional inactivation of the enzyme, β-galactosidase.
Thus (a) is correct option.

VERY SHORT ANSWER QUESTIONS

91. Give the characteristic feature and source organism of the DNA polymerase used in PCR.

Ans : **OD 2005**

The DNA polymerase is thermo-stable i.e., remains active during the high temperature. The source organism is a bacterium Thermus aquaticus. The enzyme is called Taq polymerase.

92. What does the ampicillin resistant gene act as in the above case?

Ans : **FOREIGN 2005**

Ampicilin resistant gene acts as selectable marker and helps in selecting the transformant in the above case.

93. Name the two techniques that enabled the birth of modern biotechnology?

Ans : **DELHI 2019**

Genetic engineering and sterilisation method.

94. Give the name of techniques, that are used in genetic engineering.

Ans : **SQP 2010**

Creation of recombinant DNA, gene cloning and gene transfer.

95. Name the first restriction endonuclease discovered.

Ans : **FOREIGN 2015**

First restriction endonucleases Hind II was discovered by Smith Wilcox and Kelley in 1968.

96. Mention the role of restriction enzymes in recombinant DNA technology.

Ans : **DELHI 2017 ; OD 2014**

Restriction enzymes recognise the specific sequence in DNA and cut within that recognition sequence. These enzyme help in cutting the genes and plasmids and produce sticky or blunt ends.

97. Define biotechnology.

Ans : **OD 2014**

Biotechnology can be defined as the application of biological organisms system or processes to produce product that are useful for human beings. It is a controlled use of biological agents such as micro-organisms or cellular component for beneficial use.

98. Why is this method of selection referred to as "Insertional inactivation"?

Ans : **OD 2005**

Due to the insertion of gene of interest (insert) within the gene (enzyme producing), the functioning of the gene is inactivated i.e. the concerning enzyme is not produced.

99. Molecular scissors used in recombinant DNA technology are known as.

Ans : **COMP 2016**

Restriction enzymes.

100. What is the host called that produces a foreign gene product? What is this product called?

Ans : **DELHI 2015**

Competent host organism. The product is called recombinant molecule.

101. Define vector in terms of biotechnology?

Ans : **SQP 2007**

The DNA molecule that carry a foreign gene segment and replicate inside host cell is called vector.

102. Give the name of bacterium other than E. coli, which is used in recombinant DNA technology.

Ans : **FOREIGN 2020**

Salmonella typhimurium

103. Why is 'plasmid' an important tool in biotechnology experiments?

Ans : **OD 2013**

Since plasmids can replicate within the bacterial cell independently of the genornic DNA, any alien DNA ligated to it will also multiply, i.e. it is used as a vector as well as in gene cloning.

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104. Name the technique that is used to alter the chemistry of genetic material (DNA, RNA) to obtain desired result.

Ans : **DELHI 2016**

Genetic engineering.

105. Why are bacteriophages used as vectors in RDT?

Ans : **COMP 2019**

Bacteriophages are used as vectors because of very high copy number of their genome within the bacterial cells. Also they have the ability to gain an easy entry into the bacterial hosts in order to produce large number of recombinant DNA.

106. Why is it not possible for an alien DNA to become part of a chromosome anywhere along its length and replicate normally?

Ans : **OD 2014**

Origin of replication is the sequence from where replication start. An alien DNA must be linked to this sequence to be able to replicate within the host cell.

107. Write the significance of adding proteases at the time of isolation of genetic materials.

Ans : **COMP 2010**

Protease is added because it helps in digesting proteins and helps in the breakdown of cell wall by dissolving it.

108. State what happens when an alien gene is ligated at Sal I and Pvu I site of pBR322 plasmid?

Ans : **DELHI 2020**

In case of ligation at Sall site, the transformant loses the tetracycline resistance while, in case of Pvu I, the transformant loses ampicillin resistance.

109. How is Agrobacterium tumefaciens able to transform a normal plant cell into a tumour?

Ans : **SQP 2006**

When it infects a plant cell, it delivers a part of its DNA, called T-DNA for Tumour inducing (Ti plasmid) into the plant cell and transforms it into a tumour cell.

110. What would be the molar concentration of human DNA in a human cell? Consult your teacher.

Ans : **FOREIGN 2016**

3 mm/L.

111. How can you remove DNA which is separated out from a cell suspension?

Ans : **OD 2005**

By spooling method

112. What is the purpose of using Mgt' during annealing process of PCR?

Ans : **DELHI 2019**

Mg^{2+} is required as a cofactor for thermostable DNA polymerase.

113. Write the function of a bioreactor.

Ans : **OD 2017**

A bio-reactor is a large vessel in which raw materials are biologically converted into specific products individual enzymes, etc., using microbial, plant, animal or human cell.

114. Define modern biotechnology.

Ans : **SQP 2008**

The branch of biotechnology which is done by altering the original DNA sequence of an organisms by using recombinant DNA technology.

115. What are the sampling port in a bioreactor?

Ans : **FOREIGN 2015**

The main function of sampling port is to withdraw culture periodically.

SHORT ANSWER QUESTIONS

116. What is micro-injection? How it is helpful in recombinant DNA technology?

Ans : **OD 2018**

Micro-injection is a technique of injecting or delivering foreign DNA into a living cell (a cell, egg, oocyte, embryos of animals) through a glass micro-pipette. The process of delivering foreign DNA is done under a powerful microscope.

This technique is ideally used in recombinant DNA technology for the production of transgenic animals and has following advantages.

1. It use no chemical, leaves no residue.
2. The small structures can be injected containing only a few cells and with hight regeneration potential.
3. Since it is a direct physical approach, it is host-range-independent.

NODIA

117. What is DNA probe? Give its application in Biotechnology.

Ans : **OD 2017**

A probe is a molecule (DNA or RNA segment) that recognizes the complementary sequence in DNA or RNA molecules by molecular hybridization and thus allows identification and isolation of these specific DNA sequences from on organism.

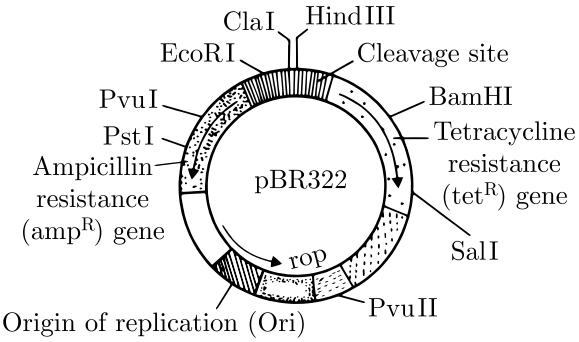
Probes are always single stranded and have a

cloned in a vector whose origin support high copy number rop : rop codes for protein involved in the replication of plasmid amp : gene for ampicillin resistance which help in selecting transrformants.

151. Draw a schematic diagram of the E. coli cloning vector pBR322 mark the following in it :

1. ori
2. rop
3. ampicillin resistance gene
4. tetracycline resistance gene
5. rrestriction site Bam HI
6. restriction site EcoRI

Ans : SQP 2005



152. What are recombinant proteins? How do bioreactors help in their production?

Ans : COMP 2008

Recombinant protein is a protein obtained by introducing recombinant DNA into a heterologous host and causing it to produce the gene product. Bioreactors are vessels in which raw materials are biologically converted into specific products. A bioreactor provides the optimal conditions for achieving the desired product by providing optimum growth conditions (temperature, pH, substrate, salts, vitamins, oxygen). To maintain a higher yield, optimum temperature, must be maintained and suitable pH must be provided.

153. Describe the roles of heat, primers and the bacterium Thermus aquatics in the process of PCR.

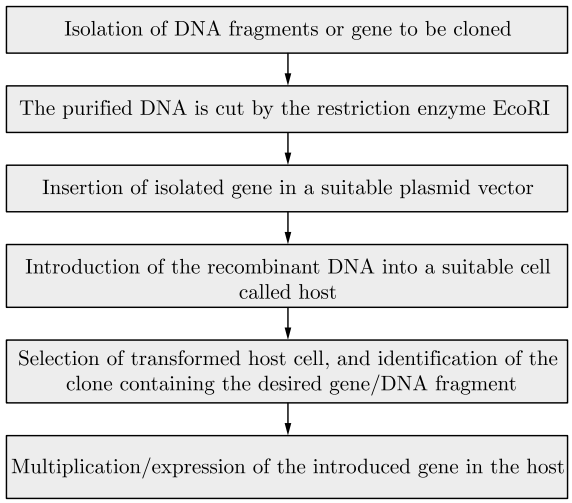
Ans : DELHI 2015

In the process of PCR (polymerase chain reaction), the role of heat, primer and thermus aquaticus is as follows :

1. **Heat :** This step is known as denaturation. In this, the target DNA is heated to a high temperature (94° to 96°C) resulting in the separation of two strands.
2. **Primer :** In this step, i.e., annealing, the two oligonucleotide primers anneal to each of the DNA template since the sequence of the template DNA. Presence of primer is important for polymerisation to take place. Temperature ($40^\circ\text{C} - 60^\circ\text{C}$) is kept low depending on the length and sequence of primers.
3. **Thermus Aquaticus :** It is a source of thermostable DNA polymerase (Taq polymerase). It is used in the final step of PCR called polymerisation. This helps in synthesis of DNA region between the primers, using deoxynucleoside triphosphates and Mg^{2+}.

154. Prepare a flow chart in formation recombinant DNA by the action of restriction endonuclease enzyme Eco RI.

Ans : FOREIGN 2009



1. Isolation of DNA fragments or gene to be cloned.
2. The purified DNA is cut by the restriction enzyme Eco RI.
3. Insertion of isolated gene in a suitable plasmid vector.
4. Introduction of the recombinant DNA into a suitable cell called host.
5. Selection of transformed host cell, and identification of the clone containing the desired gene/DNA fragment.
6. Multiplication/expression of the introduced gene in the host.

155. A mixture of fragmented DNA was electrophoresed in an agarose gel. After staining the gel with ethidium bromide, no DNA bands were observed. What could be the reason?

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genetic makeup of cells, including the transfer of genes within and across species boundaries to produce improved or novel organisms. New DNA is obtained by either isolating and copying the genetic material of interest using recombinant DNA methods or by artificially synthesizing the DNA. A construct is usually created and used to insert this DNA into the host organism.

123. Can you list 10 recombinant proteins which are used in medical practice? Find out where they are used as therapeutics. (Use the internet)

Ans : **OD 2009**

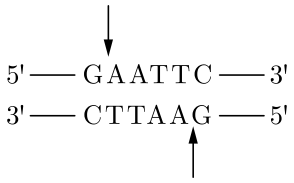
	Recombinant Proteins	Therapeutic uses
1.	Insulin	Used in diabeters mellitus
2.	OKT-3	Therapeutic antibody, used for reversal of transplantation rejection
3.	DNase	Treatment of cystic fibrosis
4.	Reo Pro	Prevention of blood clots
5.	Blood clotting factor VIII	Treatment of Haemophilia A
6.	Blood clotting factor IX	Treatment of Haemophilia B
7.	Tissue Plasminogen activator	For acute myocardial infarction
8.	Interferon alpha (INF alpha)	Used for Hepatitis C
9.	Interferon beta (INF beta)	Used for Multiple sclerosis
10.	Interferon gamma (INF gamma)	Used for granulomatous disease

124. Make a chart (with diagrammatic representation) showing a restriction enzyme, the substrate DNA on which it acts, the site at which it cuts DNA and the products it produces.

Ans : **COMP 2005**

Restriction enzyme - Eco RI

Substrate DNA and cleaving site –



Products–

125. Besides better aeration and mixing properties, what other advantages do stirred tank bioreactors have over shake flasks?

Ans : **DELHI 2017**

Shake flasks are used for growing microbes and mixing thedesired materials on a small scale in the lab. But the large scale production of desired biotechnological product requires large stirred tank bioreactors.

Besides better aeration and mixing properties, the bioreactors have following advantages -

1. It has oxygen delivery system
2. It has a foam control, temperature and pH control system.
3. Small volumes of culture can be withdrawn periodically.

126. Can you think and answer how a reporter enzyme can be used to monitor transformation of host cells by foreign DNA in addition to a selectable marker?

Ans : **DELHI 2011**

Reporter enzyme can differentiate recombinants from non-recombinants on the basis of their ability to produce specific color in the presence of a chromogenic substrate. A rDNA is inserted within the coding sequence of the enzyme, β -galactosidase. This results into inactivation of the enzyme which is referred to as insertional inactivation.

The presence of a chromogenic substrate gives blue coloured colonies, if the plasmid in the bacteria does not have an insert. Presence of insert results into insertional inactivation of the β-galactosidase and the clonies do not produce any colour. These are identified as recombinant colonies.

127. Describe briefly the followings

1. Origin of replication
2. Downstream processing

Ans : **FOREIGN 2009**

1. **Origin of Replication (ori) :** This is a sequence form where replication starts and any piece

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the gene which inactivates the functioning of gen. Insertional inactivation is a efficient method to identify transformants.

Example : Blue-whit selection method : In this method, cloned DNA is inserted into the lac Z gene present on the vector. After insertion the lac Z gene is inactivated. The lac Z gene forms β- galactosidase enzyme which can break *X*-gal (a synthetic colourless substrate) into a blue coloured product. Thus, trasformants will contain interrupted lac Z gene which will not produce β -galactosidase, appear in white colonies in the presence of *X*-gal.

141. Explain the work carried out by Cohen and Boyer that contributed immensely in biotechnology.

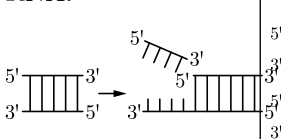
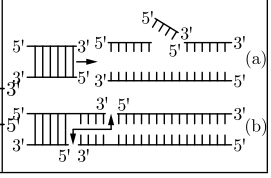
Ans : **DELHI 2005**

Cohen and Boyer contributed to the field of biotechnology by constructing the first recombinant DNA molecule in 1972. They cut the piece of DNA from a plasmid carrying antibiotic resistance gene, using restriction enzymes. This piece of foreign DNA, was linked with the plasmid DNA, acting as a vector with the help of enzyme DNA ligase. This newly formed DNA molecule is called recombinant DNA.

142. How is the action of exonuclease different from that of endonuclease?

Ans : **COMP 2009**

Differences between action of exonucleases and endonucleases area s follows:

	Exonuclease	Endonuclease
1.	These nucleases cleave base pairs of DAN at their terminal ends.	They cleave DNA at any point except the terminal ends.
2.	They act on single strand of DNA or gaps in double stranded DNA.	They cleave one strand or both strands of double stranded DNA.
3.	They do not cut RNA. 	They may cut RNA. 

143. Explain how to find whether an E. coli bacterium has transformed or not when a recombinant DNA bearing ampicillin resistant gene is transferred into it.

Ans : **SQP 2020**

If the recombinant DNA bearing ampcillin resistant is transferred into E. coli bacteria, it will confer resistance to ampicillin and therefore will grow on ampicillin containing medium. However the non-transform-ants will not grow on same medium. The recombinants or transformed E. coli can be selected by use of selectable markers. The transformants must be plated on a plate bearing ampicillin containing medium. Hence, transformants can be selected from non-transformants.

144. List the key tools used in recombinant DNA technology.

Ans : **FOREIGN 2010**

Biological or key tools used in recombinant DNA technology are:

1. **Enzymes :** Different kinds of specific enzymes used in recombinant DNA technology are lysing enzymes (Used to open up the cells to get DNA), it includes lysozyme, cellulose and chitinase and cleaving enzymes (enzymes used to break DNA molecules) it includes exonuclease, endonuclease and restriction endouclease.
2. **Cloning Vectors :** These are DNA molecules that can carry foreign DNA segment and replicate inside a host cell. It may be plasmids, a bactriophage, cosmids, Yeast Artifical Chromosomes (YACs), Bacterial Artifical Chromosomes (BACs) and viruses.
3. **Competent Host :** A competent host is essential for transformation with recombinant DNA. It includes DNA mediated or vector mediated gene transfer and direct or vector-less gene transfer (microinjection, electroporation, chemical mediated gene transfer, biolistic method or gene gun method).

145. How are recombinant vectors created? Why is only one type of restriction endonuclease required for creating one recombinant vector?

Ans : **OD 2007**

Recombinant vectors are created by cutting the vector and source DNA using the same restriction enzyme. This results in production of complementary 'sticky ends'. DNA ligase help in linking alien DNA with the plasmid DNA.

Same restriction enzyme is used for creating one recombinant vector because it recognises and cuts the DNA at a particular sequence (recognition site) and create sticky ends.

NODIA

Ans : **OD 2005**

1. Isolation of DNA.
2. Fragmentation of DNA by restriction endonucleases.
3. Isolation of desired DNA fragment.
4. Ligation of DNA fragment into vector.
5. Transferring recombinant DNA into host.
6. Culturing host cells at large scale.
7. Extraction of the desired product.

134. A recombinant DNA is formed when sticky; ends of vector DNA and foreign DNA join. Explain how the sticky ends are formed an get joined?

Ans : **DELHI 2013**

Many restriction enzymes cleave the recognition sequence asymmetrically (little away from the centre). As a result, the DNA fragments have short, single stranded overhangs at each end, which are called sticky ends. They are named so because they form hydrogen bonds with their complementary cut counter parts. This stickiness of the ends facilitates the action of DNA ligase.

135. Mention the number of primer required in each cycle of polymerase chain reaction (PCR). Write the role of primers and DNA polymerase in PCR.

Ans : **FOREIGN 2006**

Each PCR cycle requires two sets of primers

1. **Primers :** They are small oligonucleotides (usually 10-18 nucleotide long) that are complementary to the regions of DNA.
2. **DNA Polymerase :** It extends the primers using nucleotides provided in the reaction and the genomic DNA as template.

136. A recombinant vector with a gene of α - galactosidase enzyme, is introduced into a bacterium. Explain the method that would help in selection of recombinant colonies from non-recombinant ones.

Ans : **COMP 2005**

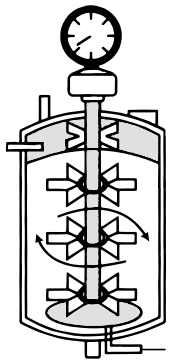
The method is based on colour reaction (Blue-white selection). The α-galactosidase enzyme can cleave a colourless, synthetic substrate, X-Gal into a blue-coloured product if the gene is inactivated by insertion of gene of interest into it, the development of blue colour will be prevented.

137. What are selectable markers? Give examples.

Ans : **FOREIGN 2010**

Selectable markers are the genes which help in identifying and eliminating non - transformants and will permit the growth of transformants only. Examples : Gene coding for resistance to ampicillin (amp^R), gene coding for resistance to tetracycline (tet^R) antibiotic.

138. Name the type of bioreactor shown. Write the purpose for which it is used.



Ans : **COMP 2011**

Simple stirred tank bioreactor.

It is used of produce large quantities of products where large volumes (100-1000 liters) of culture can be processed.

139. What essential features must be present in a cloning vector?

Ans : **SQP 2018**

Most commercial cloning vectors have key features that have made their use in molecular biology so widespread.

Control of Expressions : In the case of expression vectors, the main purpose of these vehicles is the controlled expression of a particular gene inside a convenient host organism (e.g. E. coli). Control of expression can be very important; it is usually desirable to insert the target DNA into a site that is under the control of a particular promoter. Some commonly used promoters are T7 promoters, lac promoters and cauliflower mosaic virus's 35 promoter (for plant vectors).

Selectable Marker : To allow for convenient and favourable insertions, most cloning vectors have had nearly all their restriction sites engineered out of them and a synthetic multiple cloning site (MCS) inserted that contains many restriction sites. MCSs allow for insertions of DNA into the vector to be targeted and possibly directed in a chosen orientation. A selectable marker, such as an antibiotic resistance is often carried by the vector to allow the selection of positively transformed cells. All plasmids must carry a functional origin of replication.

140. Explain the principle of insertional inactivation by giving a suitable example.

Ans : **OD 2006**

In this method a recombinant DNA is inserted in

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160. Distinguish between YAC Vs. BAC.

Ans : COMP 2015

Difference between YAC and BAC are as follows:

	YAC		BAC
1.	Called Yeast artificial chromosomes.	1.	Called Bacterial artificial chromosomes.
2.	Used to clone DNA fragments of more than 1 Mb in size.	2.	Used to clone 300-350 kb of foreign DNA.
3.	Used in mapping large genomes e.g., human genome project.	3.	Used in genome sequencing projects.
4.	Inset size is 2500-1000	4.	Insert size is 50-300.

161. Distinguish between Genomic library Vs. cDNA library

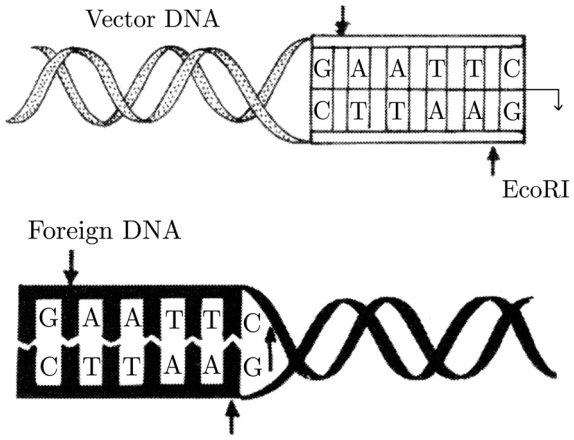
Ans : OD 2020

Differences between Genomic Library and c-DNA library :

	Genomic Library		c-DNA Library
1.	Collection of the clones showing complete genome of organism.	1.	m-RNA is cahanged into c -DNA before cloning into a vector like plasmids.
2.	Isolation of total DNA from a cell to make genomic library.	2.	m-RNA molecules are reverse transcribed by reverse transcryptase enzyme.
3.	Random fragments of genomic DNA are generated by sonication or partial restriction enzyme digestion.	3.	ss c-DNA converted into ds-DNA molecules.
4.	It carries sequences of nuclear DNA in exons as well as introns.	4.	c-DNA library carries of expressed m-RNA in exons only.

162. Draw schematic diagrams of segments of a vector and a foreign DNA with the sequence of nucleotides recognised by Eco RI.

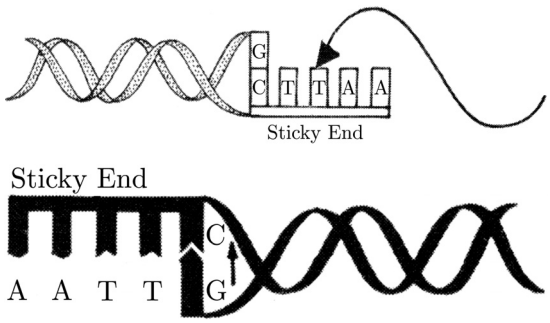
Ans : DELHI 2009



Segments of a vector and a foreign DNA with the sequence of nucleotide recognised by EcoRI.

163. Draw the vector DNA segment and foreign DNA segments after the action of Eco RI and label the sticky end produced.

Ans : FOREIGN 2010



Vector DNA segment and foreign DNA segment after the action of Eco RI.

LONG ANSWER QUESTIONS

164. What is restriction endonuclease? What is its significance in genetic engineering?

Ans : OD 2018, COMP 2015, OD 2009

A restriction enzymes is a nuclease enzyme that cleaves DNA sequence at a random or specific recognition sites known as restriction sites.

There are two different kinds of restriction enzymes

1. **Exonucleases :** It catalyses hydrolysis of terminal nucleotides from the end of DNA or RNA molecule either 5′ to 3′ direction, e.g. exonuclease I, exonuclease II. etc.

NODIA

146. Why must a cell be made 'competent' in biotechnology experiments? How does calcium ion help in doing so?

Ans : **DELHI 2011**

Competent host is essential for biotechnology experiment. Since DNA is a hydrophilic molecule,it cannot pass through membranes, so the bacterial cells must be made capable to take up DNA i.e., made competent.

This can be achieved by :

(a) **Treatment of DNA with divalent cation of $CaCl_2$ or rubidium chloride :** Treating them with a specific concentration of a divalent cation, increases the efficiency with which DNA enters the bacterium through pores in its cell wall.

(b) **Heat shock treatment of DNA :** Recombinant DNA (rDNA) can then be forced into such cells by incubating the cells with recombinant DNA on ice, followed by placing them briefly at 42° C (heat shock) and then putting them back on ice. This enables the bacteria to take up the recombinant DNA.

147. State the role of biolistic gun in biotechnology experiments.

Ans : **SQP 2005**

Biolistic gun helps in the process of gene transfer into the host cell without using a vector. In biolistic method or gene gun method, tungsten r gold particles, coated with foreign DNA are bombarded into target cells at a very high velocity. This method is suitable for plants, but is also used to insert genes into animal that promote tissue repair into cells (particularly cancer of mouth) near wounds. It has made great impact in the field of vaccine development.

148. Name and describe the technique the technique that helps in separating the DNA fragments formed by the use of restriction endonuclease.

Ans : **COMP 2020**

After the cutting of DNA by restriction enzyme, fragments of DNA are formed. Separation of DNA fragments according to their size or length is done by a technique called agarose gel electrophoresis.

It is a technique of separation of molecules such as DNA, RNA or protein, under the influence of an electrical field, so that they migrate in the direction of electrode bearing the opposite charge, vez., positively charged molecules move towards cathode (electrode) and negatively charged molecules travel towards anode (positive electrode) through a medium/matrix. Most commonly used matrix is agarose.

DNA fragments separate according to size through the pores of agarose gel. Hence the smaller, the fragment size, the farther it moves.

The separated separate according to size through the pores of agarose gel. Hence the smaller, the fragment size, the farther it moves.

The separated DNA fragments can be seen only after staining the DNA with a compound known as ethidium bromide (EtBr) followed by exposure to UV radiation. The fragments are visible as bright orange coloured bands.

149. State the function of the following in the cloning vector pBR322

1. Ori
2. Rop
3. Hindi III sites

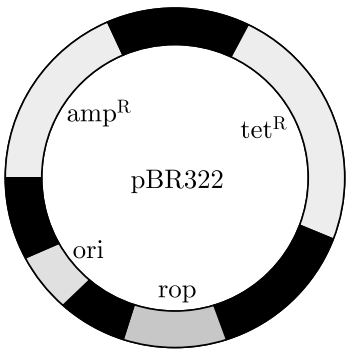
Ans : **FOREIGN 2013**

1. Origin of replication (Ori) is a specific sequence of DNA bases which is responsible for initiating replication. It is also responsible for controlling the copy number of the inked DNA.
2. Rop in pBR322 encodes for a protein involved in replication of plasmid.
3. Hind III is restriction site in pBR322. It is the site where Hind III endonuclease make a cut so that a foreign DNA segment can be introduced to this vector.

150. Draw pBR322 cloning vector. Label 'ori', 'rop' and any one antibiotic resistance site on it and state their functions.

Ans : **OD 2024, 2005**

E. coli cloning vector pBR322



Origin of replication (ori) : This is a sequence from where replication starts and any piece of DNA when linked to this sequence can be made to replicate within the host cells. This sequence is also responsible for controlling the copy number of the linked DNA. So, if one wants to recover many copies of the target DNA it should be

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of DNA when linked to this sequence can be made too replicate within the host cells. This sequence is also responsible for controlling the copy number of the linked DNA. So, if one wants to recover many copies of the target DNA it should be cloned in a vector whose origin support high copy number.

2. **Downstream Processing :** After completion of the biosynthetic stage, the product has to be subjected through a series of processes it is ready for marketing as a finished product. The processes include separation and purification, which are collectively referred to as downstream processing. The product has to be formulated with suitable preservatives. Such formulation has to undergo thorough clinical trials as in case of drugs. Strict quality control testing for each product is also required. The downstream processing and quality control testing vary from product to product.

128. Discuss with your teacher and find out how distinguish between

1. Plasmid DNA and Chromosomal DNA
2. RNA and DNA
3. Exonuclease nad Endonuclease

Ans : **SQP 2006**

1. Plasmid DNA is the DNA present outside the nucleus and chromosomal DNA is present inside the nucleus.
2. RNA is ribose nucleic acid and its main role is in protein synthesis, while DNA is deoxy-ribose nucleic acid and its main role is in carrying genetic characters.
3. Exonculeases are enzymes that work by cleaving nucleotides one at a time from the end of a polynucleotide chain. A hydrolyzing reaction that breaks phosphodiester bonds at either the 3' or the 5' end occurs. Its close relative is the endonuclease, which cleaves phosphodiester bonds in the middle of n polynucleotide chain.

129. Explain briefly

1. Chitinase
2. Plasmid DNA and Chromosomal DNA
3. Exonuclease and Endonuclease

Ans : **OD 2011**

1. Chitinase is an enzyme which breaks down the chitinuous substance present in the wall of fungi.
2. Plasmid DNA is small, double stranded circular DNA present in bacteria. They carry genes for durg resistance N_2 fixation and fertility. The chromosomal DNA is much larger in size and carry genes for other traits of the cell.
3. Exonuclease cleave base pairs of DNA at their terminal ends while endonucleases cleave DNA at specific positions within the DNA.

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130. What are bacteriophage vectors? Name the two phage vectors that are commonly used.

Ans : **COMP 2009**

Bacteriophages are viruses that infect bacterial cells by injecting their DNA into these cells. The injection DNA is selectively replicated and expressed in the host bacterial cell resulting in a number of phages which burst out of the cell and reinfect neighbouring cells. Their ability to transfer DNA from the phage genome to specific bacterial hosts during the process of bacterial infection give it to the property be used as vectors. Examples are : Phage lambda and M 13 phages.

131. What is recombinant DNA? For creating recombinant vector molecule, can two different restriction enzymes be used for cutting vector and source DNA ?

Ans : **DELHI 2010**

When a specific gene sequence is linked with plasmid vector with the help of DNA ligase, a new combination of circular autonomously replicating DNA is formed and it is called recombinant DNA.

No, recombinant vector can be created only if the same restriction enzyme cuts both the vector DNA and the source DNA, as their palindromic sequences should be same.

132. What is the principle of Gel electrophoresis? Name the compound used for staining DNA to be used in recombinant technology. What is the colour of such stained DNA ?

Ans : **SQP 2006**

Since DNA fragments are negatively charged molecules, they can be separated by forcing them to move towards the anode under an electric field through a medium or matrix (usually agarose). This matrix gel acts as sieve and DNA fragments resolve according to their size.

Ethidium bromide used for staining DNA.

Stained DAN becomes orange.

133. Enumerate the steps which are involved in recombinant DNA technology.

Ans : **OD 2016**

1. **DNA sample** that loaded on gel may have got contaminated with **nuclease** (exo-or-endo or both) enzyme and completely degraded.
2. **Electrodes** were put in opposite orientation in gel assembly which is anode towards the wells (where DNA sample is loaded). Hence DNA molecules are negatively charged, they move towards anode and so move out of gel instead of moving into matrix of gel.
3. **Ethidium bromide** was not added at all or was not added in sufficient concentration and hence DNA was not visible.

156. Describe the characteristic a cloning vector must possess.

Ans : **SQP 2010**

Characteristics of a cloning Vector : Vectors are called "Vehicles of cloning" as they act as carriers (vehicles) in carrying a foreign gene sequences into a given host cell their essential features are:

(a) It must be small in size as small fragments are easy for manipulation.

(b) It must contain Ori (Origin of Replication), capable of multiplication in host cell.

(c) Must incorporate a selectable Marker, a gene. THE selectable markers involve the enges which encode antibiotic resistance, enzymes like B-galactosidase (it is a product of lac z gene) that are identified by colour reactions easily.

157. Why DNA cannot pass through the cell membrane? Explain. How is a bacterial cell made 'competent' to take up recombinant DNA from the medium?

Ans : **FOREIGN 2020**

DNA is a hydrophilic molecule. So it is unable to pass via cell membrane. The bacterial cells are made competent to take μp r-DNA from the medium. This can be done by treating them with a particular concentration of a divalent cation say Calcium. It enhances efficiency, with that DNA enters bacterial cell through the pores in the cell walls. r-DNA is forced into cells by incubating them with r-DNA on the ice, it is followed by putting them at heatshock at 42°C and again keeping them on ice.

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158. Distinguish between Micro-injection Vs. Electroporation.

Ans : **SQP 2016**

Differences between Micro-injection and Electroporation

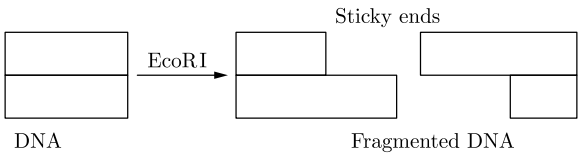
	Micro-injection		Electroporation
1.	Injection of DNA into nucleus of the cell.	1.	FOREIGN DNA into the cells by minute transient pores in cell membrane.
2.	In is done by glass micro-pipette.	2.	It is done by electric current.

159. Distinguish between0 Blunt ends Vs. sticky ends

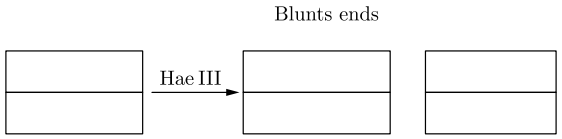
Ans : **DELHI 2019**

Difference between Blunt Ends and Sticky Ends :

	Blunt Ends		Sticky Ends
1.	A cut in the centre of recognition sequence forms blunt ends.	1.	They are short, single stranded over changes at DNA strands.
2.	Blunt ends are known as flush ends.	2.	Sticky ends are called cohesive ends.
3.	Example : 5'CCCGGG3' (Sma I) 3'GGGCCC5' 5'CCC3'+5'GGG3 3'GGG5'+3'CCC5	3.	Example : 5'GAATTC3' (EcoR I) 3'CTTAAG5' 5'G3'+5'AATTC3' 3'CTTAA5'+3'G5'



Sticky ends of DNA



Blunt ends of DNA

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label attached. The universal DNA probe is made up of repeated GATA sequence. Applications of DNA probe in biotechnology are as follows.

1. Identification of restriction fragments containing a particular gene out of hundred and thousands of restriction fragments formed from genomic library.
2. It is also used to identity genetic disorders. DNA probes have been prepared that match the sequence of many human genetic disease genes (such as cystic liberosis, muscular dystrophy) to diagnose presence of defective gene in a person's genome.
3. This technique is also used in DNA finger printing to identify the short DNA sequences.

118. What do you understand by Southern blotting technique ?

Ans : **OD 2016**

Southern blotting is a technique of DNA hybridization in which one or more specific DNA fragments are detected in a large population by means of hybridization to a labelled complementary nucleic acid probe. The method was developed by Edward Southern in 1975. The restriction fragments are first fractionated lengthwise by electrophoresis in an agarose gel. The mobility of the smallest fragment is greatest. After denaturing, the segregated fragments in the gel are transferred to a nitrocellulose membrane by placing the membrane on the gel. A flow of an appropriate buffer through gel eluted DNA fragments and blots them onto the membrane. The membrane is covered with a stack of tissue paper.

The bound DNA fragments are dissociated by the buffer into single strands. After blotting, the membrane is heated for 1-2 hours at 80CC or is exposed to UV light to fix DNA molecules to the membrane. A labelled DNA probe representing specific sequence of a gene of interest when added, is hybridized to DNA strand that is bound to the membrane. After removal of he non-bound probes by washing, the hybridized DNA's are identified by auto-radiography. The position of the band on the blot is then related to its migration and hence its size.

119. Define plasmid. Describe the structure and utility of the plasmids.

Ans : **OD 2015**

Plasmid are circular, double-stranded DNA molecules that exist in bacteria and in the nuclei of some eukaryotic cells. The size of plasmids ranges from a few kb to near 100 kb and can hold up to 10 kb fragments. They are used in genetic engineering to carry foreign DNA to generate a recombinant construct.

pBR322 is the most common and widely-used *E*. coli cloning vector. The *p* stands for plasmid and BR for Bolivar and Rodriguez, researchers who constructed it.

It is 4363 bps in length and has 40 unique restriction sites. It consists of following regions:

1. *'Rep'* replicon from plasmid pMB1 which is responsible for replication of the plasmid.
2. *'Tet'* gene encoding tetracycline resistance derived from pSC101 plasmid.
3. *'Bla'* gene encoding β-lactamase which provide ampicillin resistance.

120. Write a note on PCR.

Ans : **OD 2014**

Polymerase chain reaction is method for amplifying segments of DNA. It is an enzymatic method and carried out invitro. PCR technique was developed by kary mullis in 1983. PCR is very simple, inexpensive technique for characterization, analysis and synthesis of specific fragments of DNA or RNA from virtually any living organisms. Its various applications are as follows.

1. **Forensic Science :** DNA finger printing, paternity testing and criminal identification.
2. **Gene sequencing**
3. Vaccine production by recombinant technology.

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121. Agrobacterium tumifaciens is a natural vector. How?

Ans : **OD 2014**

Agrobacterium tumifaciens is a natural vector or natural genetic engineer of plants since these bacteria have the natural ability to transfer T-DNA of their plasmids into plant genome upon infection of cells at the wound site and cause an unorganized growth of a cell mass known as crown gall. Ti Plasmids can be used as gene vectors for delivering useful genes into target plant cells and tissues. The foreign gene is cloned in the T DNA region of Ti plasmid in place of unwanted sequences.

122. Define genetic engineering.

Ans : **OD 2009**

Genetic engineering is the science of changing the genetic structure of an animal, plant, or other organism in order to make it stronger or more suitable for a particular purpose.

It is a set of technologies used to change the

2. **Endonucleases :** They can recognize specific base sequence called restriction site within DNA or RNA molecule and cleave internal phosphodiester bonds within a DNA molecule for, e.g. Eco RI, Hind III, Bam HI, etc. They can be divided into three major classes on the basis of types of sequence recognised the nature of the cut made in the DNA.
   (a) **Type I Restriction Enzymes :** These enzymes have dual restriction and modification activities. Restriction depends upon the methylation status of the target DNA.
   (b) **Type II Restriction Enzymes :** In these enzymes restriction and modification are mediated by separate enzymes, so it is possible to cleave DNA in the absence of modification. The recognition site of type II enzyme is 4-8 nucleotides long and it cuts the DNA within the specific site. These enzymes recognize rotationally symmetrical sequence which is often referred as palindromic sequence. For example Born HI has a recognition site as GGATTC. They are widely used for mapping and reconstructing DNA in vitro.
   (c) **Type III Restriction Enzymes :** These enzymes recognize and methylate the same DNA sequence. Their cutting site is ~24-30 bb away from the recognition site.

Importance of Restriction Enzymes :

1. They are used in the process of insertion of genes into plasmid vectors during gene cloning and protein expression experiments.
2. Restriction enzymes are used for Restriction Fragment length Polymorphism (RFLP) analysis for identifying individuals or strains of a particular species.
3. They are also be used to distinguish gene alleles by specifically recognising single base changes in DNA known as single nucleotide polymorphisms (SNPs). This is only possible if a mutation alters the restriction site present in the allele.

165. Write briefly about recombinant DNA technology.

Ans : **OD 2011**

Recombinant DNA technology is the process of isolation of a desired gene from an organism of interest and transferring it to an organism of choice to yield the desired product in large quantities. It is a laboratory method in which DNA fragments from different sources are joined together to create a newly modified DNA fragment called recombinant DNA (rDNA). The basic outline of this technique is as follows:

1. **Isolation of desired gene-** First step in recombinant DNA technology is the selection of a DNA segment of interest which is to be cloned. This desired DNA segment is then isolated enzymatically.

   For this two enzymes namely "Restriction endonucleases" and DNA ligases" are used.
2. **Inserting the desired gene into a vector :** The isolated DNA are to be inserted into the genome of a host organism This process is facilitated by use of cloning vectors. They carry the desired gene from outside the cell into the host cell without any damage and further incorporate it into host cell genome. The vectors generally used are plasmid vector, Bacteriophage etc.
3. **Transfer of recombinant vector into host cell-** The recombinant vector introduce the desired gene into the host cell where it get incorporated into the genome of host. This transfer process can be accomplished by two ways
   (a) **Direct transfer :** It vector mediated transfer e.g.. Transformation, transduction.
   (b) **Direct transfer :** It carried ant by using techniques like micro injection, shot gun method, liposomes etc.
3. **Selection of transformed host cells:** The Transformed cells (or recombinant cells) are those host cells which have taken up the rDNA molecule. In this step the transformed cells are separated from the non-transformed cells by using various methods making use of marker genes.
4. **Expression and Multiplication of DNA insert in the host** : Finally, it is to be ensured that the foreign DNA inserted into the vector DNA is expressing the desired character in the hot cells. Also, the transformed host cells are multiplied to obtain sufficient number of copies. If needed, such genes may also be transferred and expressed into another organism.

166. State the principle of gel electrophoresis and mention two applications of this technique in biotechnology.

Ans : **DELHI 2016**

Gel electrophoresis : The fragments of DNA may be separated by a technique, called **gel**

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(ii) How does the efficiency of host Cell increases ?

(iii) What type of particles are used in gave gun method to introduce rDNA in plant cells.

Ans : **DELHI 2008**

(i) In heat shock method the rDNA is first transformed into host cell by incubating both on ice followed by placing them briefly at 42°C and then putting them back on ice.

(ii) The efficiency of host cells increases by simple chemical method or treatment with divalent cantions to take up rDNA plasmids.

(iii) In this method, the micros copic particles of gold tungsten are coated with the DNA of interest and bombarded on cells.

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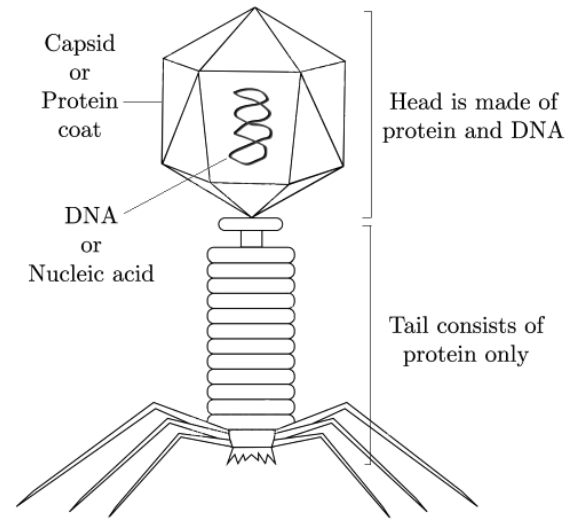
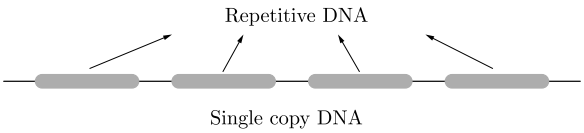
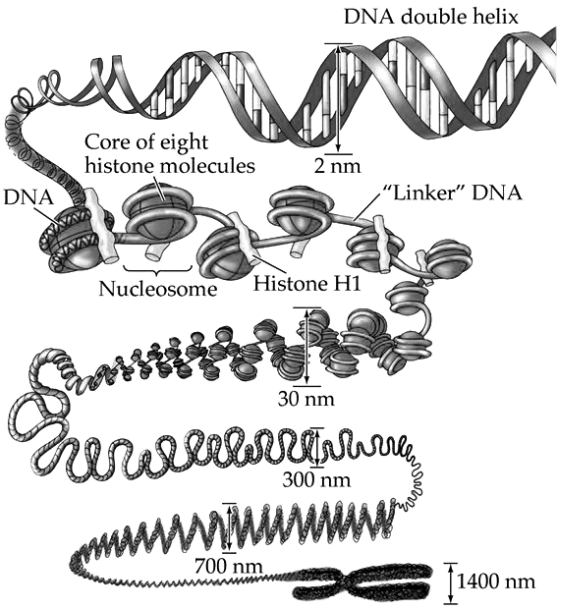




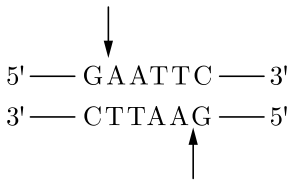


169. Explain the roles of the following with the help of an example each, in recombinant DNA technology:

1. Restriction enzymes
2. Plasmids

Ans : **COMP 2019**

1. **Restriction Enzymes :** These enzymes belongs to the class of enzymes nucleases which breaks nucleic acids by cleaving their phosphodiester bonds. They are of two types: exonucleases and endonucleases. Exonucleases remove nucleotides from the ends of DNA. The cutting of DNA at specific locations within the DNA strand is possible with the help of molecular scissors called restriction endonuclease. Restriction endonucleases make highly specific internal cuts in the DNA strand. These enzymes recognise palindromic sites within the DNA duplex and cut its strands by hydrolysing the phosphodiester bonds. Their single stranded free ends are called sticky ends which can be joined end to end by DNA ligases. Restriction endonucleases to end by DNA ligases. Restriction endonuleases serve as a tool for cutting DNA molecules at predetermined sites, which is the basic requirement for gene cloning or recombinant DNA technology. For example, restriction endonuclease Eco RI found int he colon bacteria Escherichia coli, recognises the base sequence GAATTC in DNA duplex and cuts its strands between G and A as shown below:



2. **Plasmids :** They are extra-chromosomal, self-replicating, usually circular, double-stranded DNA molecules that are found naturally in many bacteria and also in some yeast. Although plasmids are usually not essential for normal cell growth and division, yet they often confer some traits on the host organism, for example, resistance to certain antibiotics or toxins that can be a selective advantage under certain conditions. The plasmid molecules may be present as single copies or in multiple copies (500-700) inside the host organism.

These naturally occurring plasmids have been modified to serve as vectors in the laboratory. Plasmids are essential in biotechnological experiment as they help in transferring a segment of foreign DNA (gene of interest) into suitable host. Ti plasmid is widely used vector for cloning genes in plants. The most widely used, versatile, easily manipulated vector, pBR322 is an ideal plasmid vector. It was the first artificially cloned vector and is used widely in gene cloning experiments. The plasmids are cut and ligated with desired genes and transformed into the host cell for amplification to obtain the desired products. Some plasmids have antibiotic resistance

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genes which can be used as marker genes to identify recombinant plasmids from non-recombinant ones.

170. Explain the role (s) of the following in biotechnology :

1. Restriction endonuclease
2. Gel-electrophoresis
3. Selectable markers in pBR322.

Ans : **OD 2007**

1. The cutting of DNA at specific locations is possible with the help of molecular scissors called restriction endonuclease. Restriction endonucleases make highly specific internal cuts in the DNA strand. These enzymes recognise palindromic sites within the DNA duplex and cut its strands. Their single stranded free ends are called sticky ends which can be joined end to end by DNA ligases.
2. DNA fragments can be separated by gel electrophoresis. In this process, DNA strands (negatively charged) separated by forcing them to move towards the anode under an electric field through a medium/matrix. Now-a-days the most commonly used matrix is agarose gel which is a natural polymer extracted from sea weeds. The DNA fragments separate (resolve) according to their size through sieving effect provided by the agarose gel. Hence, the smaller the fragment size the farther it moves. The separated DNA fragments can be visualised only after staining the DNA with a compound known as ethidium bromide followed by exposure to UV radiation.
3. In pBR322, selectable markers are antibiotic resistance gene that help to identify transformants and eliminate non-transformatns. In case of pBR322, there are present two resistance genes tetracycline resistance (tet^R) and ampicillin resistance (amp^R).

171. Explain the significance of palindromic nucleotide sequence in the formation of recombinant DNA.

Ans : **SQP 2011**

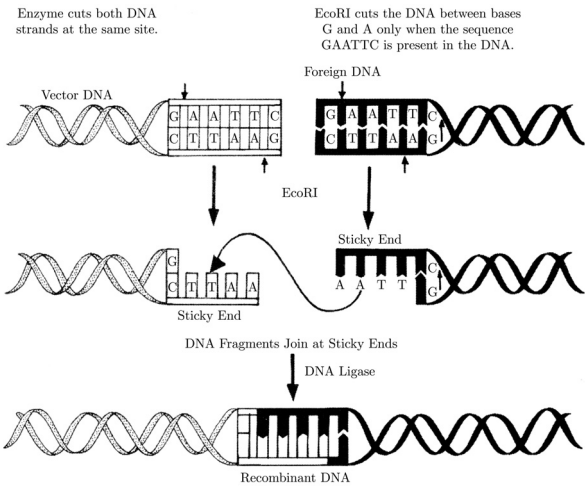
Palindromic nucleotide sequences are base pair sequences that are the same when read forward (left to right) or backward (right to left) from a central axis of symmetry. This special sequence in the DNA is recognised by restriction endonuclease and once restriction endonuclease recognises theis specific palindromic sequence, it binds to the DNA and cuts each of the two strands of the double helix at specific points in their sugar phosphate backbone. Restriction enzymes cut the strand of DNA a little away from the centre of the palindrome sites but between the same two bases of the opposite strands. This leaves single stranded unpaired bases at cut ends. These ends with unpaired bases are called sticky ends or cohesive ends. The latter are named so because they form hydrogen bonds with their complementary cut counter parts. The sticky ends facilitate the action of the enzyme DNA ligase.

172. 1. With the help of diagrams show the different steps in the formation of ercombinant DNA by action of restriction endonuclease enzyme Eco RI.

2. Name the technique that is used for separating the fragments of DNA cut by restriction endonucleases.

Ans : **DELHI 2009**

1. Enzyme cuts both DNA strands at the same site. EcoRI cuts the DNA between bases G and A only when the sequence GAATTC is present in the DNA.



2. After the cutting of DNA by restriction enzyme, fragments of DNA are formed. Separation of DNA fragments according to their size or length is done by a technique called agarose gel electrophoresis.

   It is a technique of separation of molecules such as DNA, RNA or protein, under the influence of an electrical field, so that they migrate in the direction of electrode bearing the opposite charge, viz., positively charged molecules move towards cathode (-ve electrode) and negatively charged molecules travel towards anode (+ve electrode) through a medium/matrix. Most commonly used matrix is agarose.

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DNA fragments separate according to size through the pores of agarose gel. Hence the smaller, the fragment size, the farther it moves.

The separated DNA fragments can be seen only after staining the DNA with a compound knwn as ethidium bromide (EtBr) followed by exposure to UV radiation. The fragments are visible as bright orange coloured bands.

173. 1. How has the development of bioreactor helped in biotechnology?

2. Name the most commonly used bioreactor and describe its working.

Ans : **FOREIGN 2020**

1. Small volume cultures cannot give large quantities of the product. So, the large scale production (100-1000 litres) of the products is carried out in bioreactors. Bioreactors are vessels in which raw materials are biologically converted into specific proucts by microbes, plants and animal cells and their enzymes. It provides optimal cells and their enzymes. It provides optimal growth conditions such as temperature, pH, substrate, vitamins, oxygen and salts. This type of culturing method produces a larger biomass to get higher yields of desired proteins.
2. The most commonly used bioreactor is sitrred tank bioreactor. It consists of a large stainless steel vessel with a capacity of upto 500,000 dm^3 around which there is a jacket of circulatory water used too control the temperature within the bioreactor. An agitator with a series of flat blades ensure thorough mixing of contents rotated with the help of a motor so that nutrients come in close with the micro-organisms. It also prevents setting out of the cells at the bottom. Bioreactor also has adequate arrangement for aeration, temperature and pH control. Sparger is a p porous ring at the bottom of the tank which aerates the culture. There are a number of ports though which materials can be introduced or withdrawn. A harvest line at the base of the tank extracts the culture medium and microbial products. To detect and regulate the pH and temperature changes, tank is fitted with certain probes.

174. Many copies of a specific gene of interest are required to study the detailed sequencing of bases in it. Name and explain the process that can help in developing large number of copies of this gene of interest.

Ans : **COMP 2015**

Polymerase chain reaction (PCR) is a technique of synthesising multiple copies of the desired gene (DNA segment) in vitro. The basic requirements of PCR are DNA template, two oligonucleotide primer usually 20 nucleotides long, dNTPs and DNA polymerase which is stable at high temperature (usually Taq polymerase). Working mechanism of PCR is as follows:

1. **Denaturation :** The target DNA (DNA segment to be amplified) is heated results in the separation of two strands of DNA. Each of the two strands of the targe DNA now act as template for synthesis of new DNA strand.
2. **Annealing :** During this step, two oligonucleotide primers hybridise to each of single stranded template DNA in presence of excess of synthetic oligonucleotides.
3. **Extension :** During this step, the enzyme DNA polymerase synthesises the DNA segment between the primers. Taq DNA polymerase, isolated from a thermophilic bacterium Thermus aquaticus, is used in most of the cases. This step requires presence of deoxynucleotide triphosphates (dNTPs) and Mg^{2+} and occurs at 72° C.

CASE BASED QUESTIONS

175. In recombinant DNA technology, restriction enzymes are used as they recognize and cut DNA within a specific recognition sequence. BamH I is one such restriction enzyme which binds at the recognition sequence 5' G-G-A-T-C-C 3' and cleaves this sequence between G and G on each strand, whereas Alu I binds at the recognition sequence 5' A-G-C-T 3' and cleaves these sequences between G and C on each strand.

(i) If Alu I is used to cut the given DNA strand, how many DNA fragments would be formed ? Write the sequence of each fragment formed with its polarity.

```
5′ C-C-G-T-A-G-C-T-A-T-C-A-G-C-T-G-G 3′
   | | | | | | | | | | | | | | | | |
3′ G-G-C-A-T-C-G-A-T-A-G-T-C-G-A-C-C 5′
```

(ii) Which one of the two restriction enzymes BamH I or Alu I will preferably be used on the same given DNA strand to make a recombinant DNA molecule and why ?

(b) Either the presence of antigens (proteins, glycoprotein, etc.) are detected or the antibodies produced against the pathogen are detected.

(iv) **Stem cell technology**

(a) Stem cells are undifferentiated biological cells. These can differentiate into specialised cells and can divide to produce more stem cells.

(b) Stem cells are found in multicellular organisms.

(c) Adult stem cells are used in medical therapies, for examples, in bone marrow transplantation.

(d) Stem cells can also be taken from umbilical cord blood just after birth.

4. TRANSGENIC ANIMALS

Animals whose DNA is manipulated to possess and express an extra (foreign) gene are known as transgenic animals. Transgenic rats, rabbits, pigs, sheep and cows have been produced.

Following are the common reasons for developing transgenic animals:

(i) **Study of normal physiology and development**

(a) Useful to study gene regulation, their effect on the normal functions of the body and its development.

(b) For example, study of complex growth factors like insulin-like growth factor.

(ii) **Study of disease**

(a) Study of genes which are responsible for diseases in human and their treatment.

(b) Transgenic models have been developed for many human diseases like cancer, cystic fibrosis, rheumatoid arthritis and Alzheimer's disease.

(iii) **Biological products**

(a) Useful biological products can be produced by introducing, into transgenic animals, the portion of DNA (or genes) which codes for a particular product.

(b) For example, human protein (α -1-antitrypsin) is used to treat emphysema.

(c) In 1997, the first transgenic cow, Rosie, produced human protein-enriched milk(2.4 g/L).

(d) The milk contained the human alpha-lactalbumin and was more nutritionally balanced for human babies than natural cow milk.

(iv) **Vaccine safety**

(a) Transgenic mice are developed to test safety of vaccines, before being used on humans.

(b) for examples, polio vaccine.

(v) **Chemical safety testing**

(a) Transgenic animals are made to carry genes, which make them more sensitive to the toxic substances than non-transgenic animals.

(b) On exposing to the toxic substances, their effects are studied in less time.

5. ETHICAL ISSUES

Genetic modification of organisms show unpredictable results when such organisms are introduced into the ecosystem.

The modification and use of living organisms for public services (as food and medicine sources, for examples) creates problems with patents granted.

Government of India formed the organisations like GEAC(Genetic Engineering Approval Committee) to decide the validity and safety of GM organisms for public safety.

6. BIOPIRACY

Biopiracy is defined as the use of bioresources by multinational companies and other organisations, without proper authorisation from the countries and concerned people, without compensatory payment.

7. PATENT

A patent is a set of exclusive rights granted by a state (national government) to an inventor or their assignee for a limited period of time in exchange for a public disclosure of an invention. Patents satisfy three criteria: novelty, non-obviousness, utility.

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(i) What does the given experiment show?

(ii) Which bacteria are used in the above experiment?

(iii) What would be the ratio of ^{15}N : ^{14}N DNA strands in *E.coli* extracted DNA after generation '2'?

(iv) If *E. coli* is allowed to grow in N^{15} medium for 20 minutes and in N^{14} medium for next 40 minutes, then what will be the number of hybrid and light double stranded DNA molecules respectively?

Ans : **COMP 2012**

(i) The shown DNA replication is said to be semi-conservative as after the completion of replication, each DNA molecule would have one parental and one newly synthesised strand.

(ii) E. coli bacteria cells are used in the given experiment.

(iii) According to the shown demonstration, after two generation, we will obtain 75% light ($^{14}N^{14}N$) DNA strands and 25% hybrid ($^{15}N^{14}N$) DNA strands. So, the ratio of ^{15}N : ^{14}N DNA strands will be 1 : 3.

(iv) If E.coli culture is allowed to grow in ^{15}N medium for 20 minutes and in ^{14}N medium for next 40 minutes, then there would be 6 light dsDNA molecules and 2 hybrid dsDNA molecules.

178. In 1972, Cohen and Boyer isolated the antibioticresistance gene by cutting out a piece of DNA from a plasmid which was responsible for conferring antibiotic resistance and produced a recombinant DNA as shown in the figure given below :

(i) How was it possible for them to cut DNA at a specific position ?

(ii) Name the processes involved in producing a recombinant DNA.

(iii) Which enzyme was used to ligate the DNA and produce a recombinant DNA ?

Ans : **OD 2005**

(i) DNA can be cut at specific sites by using enzymes restriction endonucleases. These are also known as molecular scissors.

(ii) Various processes involved in recombinant DNA technology are :

(a) Isolation of the genetic material (DNA),

(b) Cutting of DNA at Specific Locations,

(c) Amplification of Gene of Interest using PCR,

(d) Insertion of Recombinant DNA into the Host Cell/Organism,

(e) Obtaining the FOREIGN Gene Product.

(iii) The cut DNA can be joined together (end-to-end) using DNA ligases enzymes.

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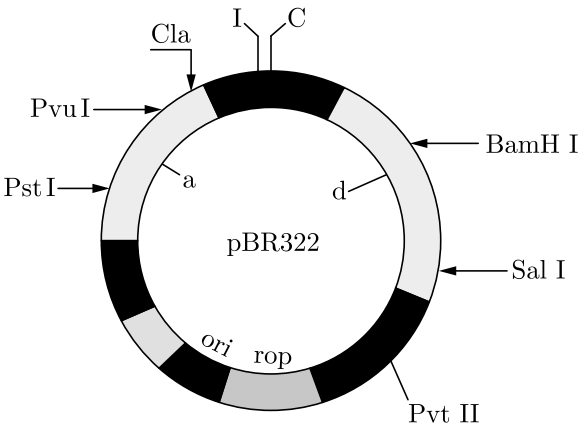
179. Observe the figure of the plasmid pBR322.



(i) Identify the selectable marker in the given figure.

(ii) How is the coding sequence of the b–galactosidase considered a better marker than the ones identified by you in the figure.

(iii) Why is it necessary to have a selectable marker in the cloning vector ?

Ans : **OD 2005**

(i) $a-$gene for ampicillin resistance tet-gene for tetracycline resistance

(ii) The insertion of $r-$DNA into the coding sequence of an enzyme $\beta-$galactosidase leads to the inactivation of the enzyme. This is called insertional inactivation. The recombinants do not produce blue coloured colonies in the presence of chromogenic substrate while the non-recombinants produce a blue colour. Thus, coding sequence of $\beta-$galactosidase is a better marker.

(iii) Selectable markers are essentials to identify and eliminate non-transformant by selectively permitting the growth of the transformant cells.

180. DNA being hydophilic cannot pass through the cell membrance of a host cell. Thus, it need to be made competent by one or the other way to get introduced into the host cell.

(i) What does heat shock method refers to ?

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(iii) After binding to the two strands of the double helix DNA, where specifically does the restriction enzyme act to cut the two strands of DNA ? Write the specific term used for the specific nucleotide sequences of DNA recognised by a restriction endonuclease.

(iv) Write the specific sequence of DNA segment recognised by the restriction endonuclease EcoRI.

Ans : **SQP 2010**

(i) 3/Three fragments

5′ – C – C – G – T – A – G 3′
3′ G – G – C – A – T – C

5′ – C – T – A – T – C – A – G 3′
3′ – G – A – T – A – G – T – C 5′

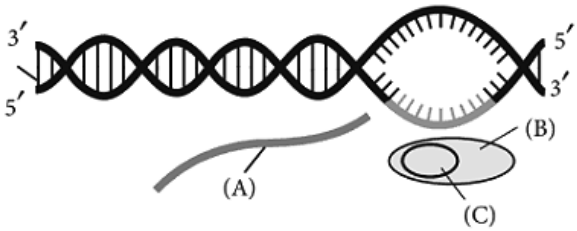
5′ C – T – G – G – 3′
3′ G – A – C – C – 5′

(ii) Alu I, Alu I site is present in the given sequence and BamH I site is not given.

(iii) (a) Sugar phosphate backbone
(b) Palindrome sequence/recognition site/ restriction site

(iv) (Note : 1 mark for polarity and 1 mark for correct sequence)

176. The process of copying genetic information from template strand of DNA into RNA is called transcription. It is mediated by RNA polymerase. Transcription takes place in the nucleus of eukaryotic cells. In transcription, only a segment of DNA and only one of the strands is copied into RNA. Transcription mainly consists of three steps. One of the steps of transcription is given below.



(i) Identify the given step and name the labels B and C.

(ii) What will happen if C is not available in the above process?

(iii) What changes will take place in A after the completion of above process in eukaryotes?

(iv) Briefly explain the previous step or given figure taking place in prokaryotes.

Ans : **FOREIGN 2010**

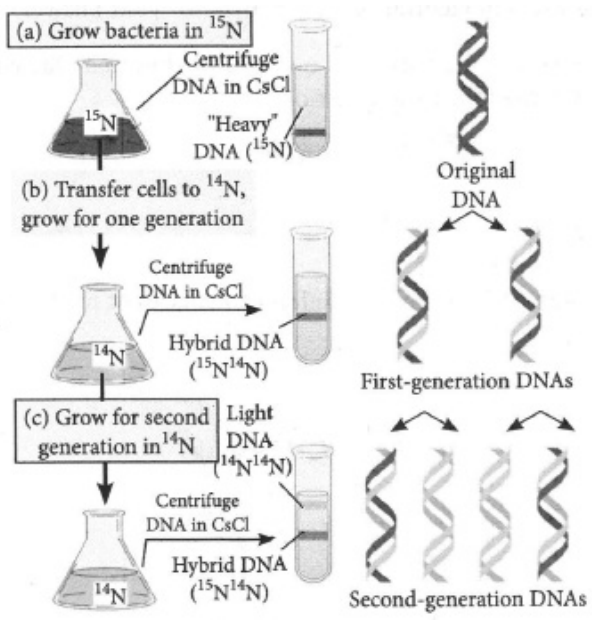
(i) The given figure represents the termination process during transcription in bacteria. A is mRNA transcript, B is RNA polymerase and C is Rho factor.

(ii) When RNA polymerase reaches to termination region, rho factor finds it and alters its specificity. As a result, the process of transcription terminates if Rho factor is absent, termination will not occur.

(iii) After the completion of transcription, in eukaryotes, the newly formed RNA undergoes three processes, namely, splicing, capping and tailing.

(iv) With the help of RNA polymerase the adjacent ribonucleotides held over DNA template to form RNA chain. As the RNA chain formation initiates, the sigma (σ) factor of the RNA polymerase separates. RNA polymerase (core enzyme) moves along the DNA template causing elongation of RNA chain at the rate of some 30 nucleotides per second. RNA synthesis stops as soon as polymerase reaches the terminator region.

177. In 1958, Matthew Meselson and Franklin Stahl provided a strong experimental evidence to prove the template mechanism of DNA replication given by Watson and Crick. They used heavy (^{15}N) and light (^{14}N) isotopes of nitrogen to differentiate between parental and newly synthesised DNA strands. The experiment and results are diagrammatically shown below.



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CHAPTER 10

BIOTECHNOLOGY AND ITS APPLICATIONS

SUMMARY

1. INTRODUCTION

Biotechnology had varied applications, some of which include

(i) therapeutics

(ii) diagnostics

(iii) genetically modified crops for agriculture

(iv) processed food

(v) bioremediation

(vi) waste treatment

(vii) energy production.

There are three critical research areas of biotechnology:

(i) providing best catalyst as improved organism, usually a microbe or pure enzyme.

(ii) creating optimal conditions by engineering for a catalyst to act.

(iii) downstream processing technologies to purify the protein/organic compound.

2. BIOTECHNOLOGICAL APPLICATIONS IN AGRICULTURE

Food production can be increased by applying biotechnology by the following ways:

(i) Agrochemical-based agriculture.

(ii) Organic agriculture.

(iii) Genetically engineered crop-based agriculture.

The green revolution succeeded in increasing food supply because of

(i) use of improved crop varieties.

(ii) use of agrochemicals (fertilisers and pesticides)

(iii) use of better management practices.

Genetically modified organisms are plants, bacteria, fungi and animals whose genes have been altered by manipulation. Which have resulted in increased tolerance. Against stresses, pests and reduced post harvest losses.

3. BIOTECHNOLOGICAL APPLICATIONS IN MEDICINE

Genetically Engineered Insulin

Production of insulin by rDNA techniques was achieved by an American company, Eli Lilly, in 1983. It prepared two DNA sequences corresponding to A and B chains of human insulin and introduced them in plasmids of E.coli for production. The A and B chains produced, were separated, extracted and combined, by creating disulfide bonds to form human insulin.

Gene Therapy

Gene therapy is a collection of methods that allows correction of gene defects, diagnosed in a child or embryo.

Molecular Diagnosis

Some techniques used for early diagnosis are:

(i) **Polymerase chain reaction**

(a) Low concentration of the pathogen in the body does not allow its detection.

(b) The nucleic acid of the pathogen (bacteria or virus) is amplified by PCR for its detection.

(c) It is being used for detection of HIV in suspected AIDS patients and genetic mutations in suspected cancer patients.

(ii) Recombinant DNA technology

(a) A single stranded DNA or RNA tagged with a radioactive molecule is called probe.

(b) In this method, a probe is allowed to hybridise to its complementary DNA in the clone of cells.

(c) The cells are then detected by autoradiography.

(d) The cell with mutated gene will not be observed on the photographic film because the probe was not complementary to the mutated gene.

(iii) **Enzyme linked immunosorbent assay (ELISA)**

(a) It is based on the principle of antigen-antibody interaction.

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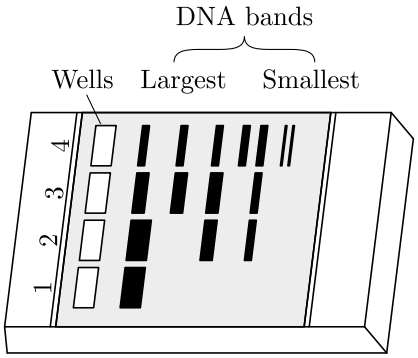
electrophoresis. The vely charged DNA fragments move towards **anode.** Gel acts as a sieve. Therefore, they may be separated by forcing them to move towards the anode under an electric field through a medium or the matrix. Agarose is used now-a-days for this. The agarose is a natural polymer. It is derived from sea weeds. The DNA fragments separate according to their size. They are visualized after staining DNA by ethidium bromide. Now these are exposed to ultraviolet radiation.

The bright orange coloured bands of DNA are then. For elution, there are many methods. THE DAN fragment is thus isolated.

Two Applications of Gel Electrophoresis :

1. For separation of DNA fragments in DNA finger-printing.



2. For separation of Macromolecules and to construct recombinant DNA by uniting to cloning vectors.

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167. In a bacterial culture some of the colonin produced blue colour in the presence of a chromogenic substrate and some did not due to the presence or obsence of an insert (rDNA) in the coding sequence of $\hat{a}$-galactosidase.

1. Mention the mechanism and the steps involved in the above experiment.
2. How is it advantageous over simultaneous plating on two plates having different antibiotics.

Ans : **FOREIGN 2005**

1. **Insertional Inactivation :** The presences of recombinants can be detected by a procedure that is based on the principle that cloned DNA fragments disrupts the coding sequence of a gene. It is called insertional inactivation. The selection of recombinants due to inactivation of antiviotics needs plating of on the 2 plates with various antibiotics. So selectable markers are developed to distinguish recombinant from a non-recombinant. It is based on their capability of producing colour in presence of chromogenic substrate.
2. It is simple and easy method to select recombinants from non-recombinants. r-DNA is inserted having coding sequence of $\hat{a}$-galactosidase that results into the inactivation of the enzyme or insertional inactivation.
   (a) As chromogenic substrate is present and this gives blue colour to colonies when bacterial plasmid is without insert.
   (b) If the insert is present, there is inactivation of $\hat{a}$-galactosidase (enzyme) and the colonies are incapable to produce colour and hence they are referred to as recombinant colonies.

NODIA

168. Differentiate between the gene structure in prokaryotes, eukaryotes and viruses.

Ans : **SQP 2007**

Gene Structure in Prokaryotes and Viruses : The viruses use host's genetic machinery to express and replicate their genes. A phage consists of 2 parts (1) proteins and (2) nucleic acids. Genome lies inside the capsid, the protein coat. Phage genome is either single stranded (ss) or double stranded (ds) nucleic acid molecules. Phage may have single RNA or DNA molecule. Size of genome varies in prokaryotes. M13 phage contains 10 genes. An E. coli has about 2400 genes. Majority of genes lie in only one RNA molecule or DNA molecule.

Gene Structure in Eukaryotes : The eukaryotes have 3 types of genomes-nuclear,, mitochondrial and chloroplast genomes. Genes in human genome are app 30,000-40,000. Most of the DNA is in intergenic region (it is abundant in repetitive DNA). In eukaryotes the genes lie on the chromosomes which occur in pairs. It is diploid (2N) in parents but haploid (N) in gametes. DNA is united to histones and makes nucleosomes.

All the genes in prokaryotes are arranged in linear way on a single, circular chromosome. So they are haploid organisms. The plasmids also have genes.

OBJECTIVE QUESTIONS

1. 'Flavr Savr' is a:
(a) Pesticide
(b) Chicken breed
(c) Transgenic Tomato
(d) Insecticidal Protein

Ans : OD 2024, 2010
Flavr savr is a transgenic tomato with delayed ripening and longer shelf life. It was developed by using Antisense RNA technology.
Thus (c) is correct option.

2. Silencing of gene could be achieved through the use of :
(a) Short interfering RNA (RNAi)
(b) Antisense RNA
(c) A and B Both
(d) None of these

Ans : OD 2018
Gene silencing refers to process of interruption or suppression of transcription or translation of the mRNA of target gene by mechanisms other than genetic modification. It is done by two main methods-RNA interference (RNAi) and Antisense RNA technology.
Thus (c) is correct option.

3. The first clinical gene therapy was given for:
(a) Adenosine Deaminase Deficiency
(b) Chicken Pox
(c) Diabetes Mellitus
(d) Rheumatoid Arthritis

Ans : OD 2018
The first clinical gene therapy was given in 1990 by the National Institute of Health to a 4 year old girl, named Ashanti De Silva, who suffered from a genetic condition called Severe Combined Immunodeficiency Disease (SCID).
This disorder is caused due to the deletion of the gene for Adenosine Deaminase (ADA). The mutant cell is unable to produce ADA.
Thus (a) is correct option.

4. The first transgenic cow was named as:
(a) Daisy (b) Maizy
(c) Dolly (d) Rosie

Ans : OD 2018
Rosie is the first transgenic cow. It produce milk enriched with human proteins alpha lactalbumin, which is more nutritionally balanced product than the natural cow's milk.
Thus (d) is correct option.

5. The toxic protein secreted by bacillus thuringiensis is:
(a) Tubulin (b) Insulin
(c) Cry protein (d) All of these

Ans : OD 2018
Bacillus thuringiensis posses cry gener that encodes for Bt toxin (cry protein) that have specific activities against insect species of order Lepidoptera, Diptera etc.
Thus (c) is correct option.

6. 'Cry gene' prevents which crop from boll worms?
(a) Cotton (b) Mango
(c) Tea (d) Wheat

Ans : OD 2016
Cry gene is used in the formation of genetically engineered crops such as Bt cotton that provides them resistance to boll worms. This gene encodes for Bt toxin protein that kills insects.
Thus (a) is correct option.

7. Which one of the following is possible in micro-propagation?
(a) Asexual reproduction
(b) Multiplication of genetically identical copies
(c) Sexual reproduction
(d) Both (a) and (b)

Ans : OD 2016
In vitro clonal propagation through tissue culture is referred to as micro propagation. It is the process of asexual reproduction by multiplication of genetically identical copies of individual plants.
Thus (d) is correct option.

8. Fusogen of protoplast culture is
(a) liquid nitrogen (b) PEG
(c) lactic (d) acid

Ans : OD 2015
Polyethylene glycol (PEG) is used as fusogen in protoplast culture. It cause the isolated protoplast to adhere to one another due to reduction of negative charge of protoplast and leads to tight agglutination followed by fusion of protoplast.
Thus (b) is correct option.

9. Which vitamin is present in Golden rice?
(a) Vitamin A (b) Vitamin B_{12}
(c) Vitamin C (d) Vitamin D

Ans : OD 2015
Golden rice is an genetically engineered variety of rice which synthesize beta carotene, a precursor of vitamin-A, in the edible parts of rice.
Thus (a) is correct option.

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10. Every living cell of a plant can give rise to the whole plant. This property as:
(a) Cloning (b) Somaclonal
(c) Totipotency (d) All of these

Ans : OD 2013
The ability of a single cell to divide, differentiate and give rise to whole new plant is called as totipotency.
Thus (c) is correct option.

11. Biotechnology mainly deals with
(a) industrial scale production of biopharmaceutical
(b) biological use of genetically modified microbes, fungi, plants and animals
(c) Both (a) and (b)
(d) None of the above

Ans : OD 2006
Biotechnology deals with industrial scale production of biopharmacceuticals and biological use of genetically modified microbes, fungi, plants and animals.
Thus (c) is correct option.

12. The application of biotechnology includes all except
(a) waste treatment
(b) energy production
(c) genetically modified crops
(d) conventional hybridisation

Ans : DELHI 2015
The application of biotechnology includes
(i) therapeutics
(ii) diagnostics
(iii) genetically modified crops for agriculture
(iv) processed food
(v) bioremediation
(vi) waste treatment and
(vii) energy production.
It do not have conventional hybridisation technique.
Thus (d) is correct option.

13. Organic agriculture is a technique of raising crops for
(a) increased food production
(b) reduction in required labour
(c) increasing the use of agrochemicals
(d) none of the above

Ans : SQP 2009
Organic agriculture aimed at reducing the need for chemical fertilisers and pesticides, which are harmful to both mankind and environment.
Thus (d) is correct option.

14. Use of genetically modified crops in crop field may
(a) reduce the harmful effects of fertilisers
(b) maximize yield
(c) be environment friendly
(d) All of the above

Ans : FOREIGN 2020
Use of GMO's may reduce the harmful effects of fertilisers, maximize yield and they can be environment friendly.
Thus (d) is correct option.

15. Which of the following statement (s) is/are true about green revolution?
(a) It succeeded in tripling the food supply
(b) Used agrochemicals
(c) Used improved crop varieties
(d) All of the above

Ans : COMP 2013
Green revolution was started to meet the food demands of increasing population.
Thus (d) is correct option.

16. Plants, bacteria, fungi and animals whose genes have been altered by manipulation are called
(a) genetically modified organisms
(b) hybrid organisms
(c) pest resistant organisms
(d) insect resistant organisms

Ans : OD 2005
Genes of plants, bacteria, fungi and animals have been altered by genetic manipulations therefore, these organisms are called Genetically Modified Organisms (GMO's).
Thus (a) is correct option.

17. All are the biotechnological applications in order to increase food production, except
(a) pisciculture
(b) agrochemical based agriculture
(c) organic agriculture
(d) genetically engineered crop-based agriculture

Ans : DELHI 2013
Food production can be increased by applying biotechnology in the following ways
(i) Agrochemical based agriculture
(ii) Organic agriculture
(iii) Genetically engineered crop based agriculture
Fish farming in isolated water bodies is called pisciculture.
Thus (a) is correct option.

NODIA

18. Choose the correct option about agrochemicals.
(a) These are expensive for farmers in developing countries
(b) Also have harmful effects on environment
(c) Genetically modified crops are less expensive than agrochemicals.
(d) Both (a) and (b)

Ans : SQP 2016
Agrochemicals are expensive for local farmers in developing countries and they also have harmful effects on the environment.
Thus (d) is correct option.

19. Which of the following *Bt* crops is being grown in India by the farmers?
(a) Maize (b) Cotton
(c) Brinjal (d) Soybean

Ans : FOREIGN 2018
In India *Bt* cotton is grown by farmers extensively. *Bt* toxin is produced by a bacterium Bacillus thuringiensis (*Bt*).
Examples of *Bt* crops are *Bt* corn, rice, tomato, potato and soybean, etc.
Thus (b) is correct option.

20. Which bacteria was the first to be used as biopesticide on the commercial scale in the world?
(a) Bacillus thuringiensis
(b) Escherichia coli
(c) Pseudomonas aeruginosa
(d) Agrobacterium tumefaciens

Ans : OD 2019
Bacillus thuringiensis spores were first used as biopesticides on the commercial scale in the world.
Thus (a) is correct option.

21. GM crops are designed to develop the natural resistance from insects and pests. Which of the following crops are modified using Bacillus thuringiensis?
(a) Tobacco and cotton (b) Tomato and rice
(c) Maize and sugercane (d) Tomato and wheat

Ans : SQP 2007
In *Bt* cotton and *Bt* Tobacco insect resistant genes are transferred from Bacillus thuringiensis.
Thus (a) is correct option.

22. In *Bt* cotton, the *Bt* protein
(a) increases the protein content
(b) stops the larva to feed further
(c) stops egg laying of adult
(d) produces more cotton

Ans : COMP 2020
Toxic proteins produced by *Bt* cotton becomes active in insect larvae gut and birds with epithelial cells, creating pores and ultimately death of insects.
Thus (b) is correct option.

23. Insect resistant transgenic cotton has been produced by inserting a piece of DNA from
(a) an insect (b) a bacterium
(c) a wild relative of cotton (d) a virus

Ans : COMP 2016
Insect resistant transgenic cotton has been produced by inserting a piece of DNA from a bacterium Bacillus thuringiensis.
Thus (b) is correct option.

24. Some strains of Bacillus thuringiensis produce proteins that kill insects like
(a) lepidopterans (b) coleopterans
(c) dipterans (d) All of these

Ans : DELHI 2015
Bacillus thuringiensis produces wide range toxins that kill insects like lepidopterans, coleopterans and dipterans.
Thus (d) is correct option.

25. *Bt* toxin is
(a) intracellular crystalline protein
(b) extracellular crystalline protein
(c) intracellular monosaccharide
(d) extracellular polysaccharide

Ans : FOREIGN 2009
Bt toxin is an intracellular crystalline protein. Specific *Bt* toxin genes obtained from Bacillus thuringiensis are used in several crop plants like cotton.
Thus (a) is correct option.

26. Bacillus thuringiensis forms protein crystals which contain a
(a) toxic insecticidal protein
(b) non-toxic insecticidal protein
(c) simple protein
(d) simple lipids

Ans : OD 2016
Bacillus thuringiensis form protein crystals which contain a toxic insecticidal protein (*Bt* toxin).
Thus (a) is correct option.

27. *Bt* toxin protein crystals present in bacterium Bacillus thuringiensis, do not kill the bacterial because
(a) bacteria are resistant to the toxin

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transgenic animals. Transgenic rats, rabbits, pigs, sheep and cows have been produced.
Thus (a) is correct option.

61. Transgenic animals are those which have foreign
(a) DNA in all of its cells
(b) Proteins in all of its cells
(c) RNA in all of its cells
(d) RNA in some of its cells

Ans : OD 2005
Transgenic animals are those, which have foreign DNA in all of its cells.
Thus (a) is correct option.

62. Transgenic animals can be used to
(a) study normal physiology
(b) study vaccine safety
(c) to produce biological products
(d) All of the above

Ans : DELHI 2010
Transgenic animals can be used to study normal physiology, vaccine safety and to produce biological products, etc.
Thus (d) is correct option.

63. Transgenic animals that serve as model to study many human diseases such as .....
(a) Alzheimer's (b) cancer
(c) night-blindness (d) Both (a) and (b)

Ans : SQP 2015
Transgenic models exist for many human diseases such as cancer, cystic fibrosis rheumatoid arthritis, Alzheimer's disease, etc.
Thus (b) is correct option.

64. Name the disease that has treated using α -I-antitrypsin developed via r-DNA technology.
(a) Cystic fibrosis
(b) Emphysema
(c) Phenylketonuria
(d) Rheumatoid arthritis

Ans : OD 2009
Emphysema can be treated using α-I-antitrypsin via r-DNA technology.
Thus (b) is correct option.

65. Which of the following transgenic human protein product has been used to treat emphysema?
(a) α-1-antitrypsin (b) α-1 globulin
(c) Cry IAb protein (d) Cry IIAc protein

Ans : DELHI 2018
Useful biological products can be obtained by introducing desired genes into the transgenic animals.
For example, transgenic animals to produce human protein (α-1-antitrypsin) is used to treat emphysema.
Thus (a) is correct option.

66. Which gene was introduced in the first transgenic cow?
(a) Human α-lactalbumin
(b) α-1-antitrypsin
(c) β-1-antitrypsin
(d) cry-IAc

Ans : FOREIGN 2020
Gene for Human α-lactalbumin was introduced into the first transgenic cow to produce human protein enriched milk.
Thus (a) is correct option.

67. In 1997, the first transgenic cow, Rosie produced
(a) human protein enriched milk (2.4 g/L)
(b) human protein enriched milk (2.8 g/L)
(c) human calcium enriched milk (2.4 g/L)
(d) human calcium enriched milk (2.8 g/L)

Ans : COMP 2006
In 1997, the first transgenic cow, Rosie produced human protein enriched milk (2.4 g/L). The milk contained the human alpha-lactalbumin ans was nutritionally more balanced for the human babies than normal cow milk.
Thus (a) is correct option.

68. Which of the following transgenic animals are used in testing safety of polio vaccine before they are sued on human?
(a) Transgenic cow
(b) Transgenic monkey
(c) Transgenic mice
(d) Transgenic sheep

Ans : SQP 2020
Transgenic mice are developed to tests the safety of polio vaccine before being used on human.
Thus (c) is correct option.

69. What is the term used for animals made to carry genes which make them more sensitive to the toxic substances than other normal animals?
(a) Transgenic (b) Transversion
(c) Transition (d) Transformant

Ans : FOREIGN 2010
Transgenic animals are made to carry the genes, which make them more sensitive to the toxic substances than other normal animals.
Thus (a) is correct option.

NODIA

translation of the mRNA (silencing).
Thus (b) is correct option.

37. Silencing of an unwanted gene could be achieved by the use of
(a) RNAi
(b) DNA polymerase
(c) Restriction enzymes
(d) None of the above

Ans : **DELHI 2015**
Silencing of a gene could be achieved through the use of RNAi interference.
Thus (a) is correct option.

38. Tobacco plant resistant to a nematode have been developed by the introduction of DNA, which is produced (in the host cells) as
(a) an antifeedent
(b) both sense and antisense RNA
(c) a particular hormone
(d) toxic protein

Ans : **FOREIGN 2015**
In RNA interference process, by using Agrobacterium vector, nematode specific genes were introduced into the host plants, which produce both sense and antisense RNA is the host cells.
Thus (b) is correct option.

39. The first human hormone produced by recombinant DNA technology is
(a) insulin (b) oestrogen
(c) thyroxin (d) progesterone

Ans : **OD 2005**
The first human hormone produced by recombinant DNA technology is insulin. It is peptide hormone, which controls the level of blood sugar. It is formed by joining two polypeptide chains by disulphide bonds.
Thus (a) is correct option.

40. What is the demerit of using bovine insulin (from cow) and porcine insulin (from pig) in diabetic patients?
(a) It leads to hypercalcemia
(b) It is expensive
(c) It may cause allergic reactions
(d) It may lead to mutations is human genome

Ans : **DELHI 2018**
Insulin obtained from the pancreas of cattle and pigs slightly differ from the human insulin in their amino acid sequences.
Also, the injection of insulin into the patients, occasionally produces sensitivity reaction and side effects.
Thus (c) is correct option.

41. Which polypeptide chain is removed during the maturation of proinsulin into insulin?
(a) A-chain (21 amino acid)
(b) B-chain (30 amino acid)
(c) C-chain (33 amino acid)
(d) A and B chain

Ans : **SQP 2009**
Insulin contains two short polypeptide chains, chain-A and B-chain, linked by disulphide bridge. In mammals, insulin is synthesised as prohormone (that needs to be processed to become mature and functional hormone). It contains an extra stretch called C-peptide. C-peptide is absent in mature insulin and is removed during the maturation into insulin.
Thus (d) is correct option.

42. The first human drug made by genetic engineering technique was
(a) insulin (b) paracetamol
(c) streptomycin (d) none of these

Ans : **COMP 2020**
The first insulin human drug made by genetic engineering technique was insulin. Insulin is an important life saving drug for diabetic patients.
Thus (a) is correct option.

43. In 1983, Eli Lilly an American company, first prepared two DNA sequences corresponding to A and B-chains of the human insulin and introduced them in the plasmids of Escherichia coli to produce insulin chains. Chains A and B were prepared separately, extracted and combined by creating
(a) hydrogen bond (b) disulphide bond
(c) covalent bond (d) peptide bond

Ans : **SQP 2020**
The chains-A and B produced were separated, extracted and combined by creating disulphidebonds bonds to form human insulin.
Thus (b) is correct option.

44. Which step was proved to be the main challenge in the producing of human insulin by recombinant DNA technology?
(a) Splitting A and B-peptide chain
(b) Addition of C-peptide to proinsulin
(c) Getting insulin assembled into mature form
(d) Removal of C-peptide from active insulin

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(b) bacteria enclose toxins in a special sac
(c) toxins occur as inactive protoxins in bacteria
(d) None of the above

Ans : **DELHI 2013**
Bt toxin protein crystals present in bacterium Bacillus thuringiensis, do not kill the bacteria themselves because toxins occur as inactive protoxin in bacteria.
Thus (c) is correct option.

28. *Bt* toxin kills insects by
(a) inhibiting protein synthesis
(b) generating excessive heat
(c) creating pores in the midgut epithelial cells, leading to cell swelling and lysis
(d) obstructing a biosynthetic pathway

Ans : **SQP 2018**
Bt toxins are initially inactive protoxins but after ingestion by the insects, their inactive toxins become active due to the alkaline pH of the gut which solublise the crystals. The activated toxin binds to the surface of the midgut epithelial cells thus, creating pores which pores which cause will swelling and lysis, further leading to death of the insects.
Thus (a) is correct option.

29. The crops having cry genes needs
(a) no insecticide
(b) small amount of insecticide
(c) large amount of insecticide
(d) None of the above

Ans : **OD 2019**
Basillus thuringiensis is a natural insecticide with unusual properties that makes it useful for pest control in certain situations.
Thus (a) is correct option.

30. The choice of genes of Bacillus thuringiensis which is to be incorporated into crop depends upon
(a) crop (b) targeted pest
(c) toxin (d) Both (a) and (b)

Ans : **SQP 2005**
Most of the *Bt* toxins are insect-group specific thus the choice of gene depends upon the crop and targeted pest both.
Thus (d) is correct option.

31. Cry IIAb and cry IAc produces toxins that control
(a) cotton bollworms and corn borer respectively
(b) corn borer only
(c) cotton bollworms only
(d) nematodes and tobacco budworms respectively

Ans : **COMP 2007**
Cotton bollworms can be controlled by toxins, cry IAc and cry IIAb.
Thus (c) is correct option.

32. In which of the following plants, resistance against a nematode was introduced by implying RNAi?
(a) Tomato (b) *Bt*-cotton
(c) Tobacco (d) Golden rice

Ans : **FOREIGN 2016**
Tobacco plants have been made resistant to nematode using RNAi that is a cellular defense mechanism against viruses.
Thus (c) is correct option.

33. Which of the following nematode infects the root of the tobacco plants which reduce the production of tobacco?
(a) Wucherreria
(b) Manduca sexta
(c) Meloidogyne incognita
(d) Enterobius

Ans : **COMP 2011**
One of the common nematodes Meloidogyne incognita infects the roots of tobacco plants and causes a great loss by causing reduction in yield.
Thus (c) is correct option.

34. Transposons are also known as
(a) silenced genes (b) mobile genes
(c) pletropic genes (d)Both (a) and (b)

Ans : **DELHI 2012**
Transposons are mobile genetic elements or jumping genes.
Thus (b) is correct option.

35. 'Silencing of mRNA molecule' in order to control the production of a harmful protein has been used in the protection of plants from
(a) bettles (b) armyworm
(c) budworm (d) nematodes

Ans : **FOREIGN 2017**
Silencing of mRNA molecule in order to control the production of a harmful protein has been used to protect plants from nematodes.
Thus (d) is correct option.

36. In RNAi, genes are silence using
(a) *ds*DNA (b) *ds*RNA
(c) *ss*DNA (d) *ss*RNA

Ans : **OD 2006**
In RNA interference (RNAi) process, silencing of specific mRNA due to a complementary dsRNA takes place. The dsRNA binds and prevents the

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(c) The cells being extremely young are more receptive of gene therapy.
(d) There probably is not any advantage

Ans : **OD 2015**
The body would not reject as it has not yet recognized 'self'.
Thus (b) is correct option.

53. Which one of the following molecular diagnostic technique is used to detect the presence of a pathogen in its early stage of infection?
(a) Angiography
(b) Radiography
(c) Enzyme replacement technique
(d) Polymerase Chain Reaction (PCR)

Ans : **DELHI 2020**
PCR helps in early detection by amplification pathogens nucleic acids. Thus, can help in early detection of very low amounts of pathogenic DNA.
Thus (d) is correct option.

54. Which of the following statement is false for polymerase chain reaction?
(a) PCR can detect pathogen before it produce symptoms
(b) PCR requires amplification of nucleic and
(c) It detects genetic defects.
(d) PCR is useful only when pathogen concentration is very high in the body.

Ans : **SQP 2015**
PCR is useful even when the pathogen concentration is extremely low.
Thus (d) is correct option.

55. Technique used to detect mutated genes is called
(a) gel electrophoresis
(b) polymerase chain reaction
(c) gene therapy
(d) autoradiography

Ans : **DELHI 2015**
A single-stranded DNA or RNA joined with a radioactive molecule (probe) is allowed to hybridise to its complementary DNA. It is followed by the detection using autoradiography.
Thus (d) is correct option.

56. A single-strand of nucleic acid tagged with a radioactive molecule is called
(a) plasmid
(b) vector
(c) probe
(d) selectable marker

Ans : **FOREIGN 2020**
The molecular probes are usually single-stranded pieces of DNAs (sometimes RNAs), labelled with radio-isotopes such as p^{32}.
Thus (c) is correct option.

57. In which of the following method, a probe is allowed to hybridise to its complementary DNA in the clone of cells?
(a) Gene therapy
(b) Autoradiography
(c) Polymerase chain reaction
(d) Enzyme Linked Immuno-Sorbent Assay (ELISA)

Ans : **COMP 2015**
In autoradiography, a probe is allowed to hybridise to its complementary DNA.
Thus (b) is correct option.

58. Which one of the following is correct explanation for autoradiography?
(a) It is used for the detection of mutated genes
(b) Clone which have mutated genes will not appear on the photographic film
(c) The probe used will have only complementary genes with unmutated protein of DNA.
(d) All of the above

Ans : **OD 2008**
Mutated genes containing clones will not appear on photographic film because probe will not have complimentarity with mutated gene.
Thus (b) is correct option.

59. Which of the following technique is based on the principle of antigen-antibody interaction?
(a) PCR
(b) ELISA
(c) Recombinant DNA technology
(d) Gene therapy

Ans : **SQP 2019**
ELISA is based on the principle of antigen-antibody interactions. It can detect very small amount of proteins (antibody or antigen) with the help of enzyme (e.g. peroxidase or alkaline phosphatase).
Thus (b) is correct option.

60. Animals whose DNA is manipulated to possess and express an extra (foreign) gene are known as
(a) transgenic (b) hybrid animals
(c) transversion animals (d) All of these

Ans : **COMP 2007**
Animals whose DNA is manipulated to possess and express an extra (foreign) gene are known as

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Ans : FOREIGN 2010
The main challenge for the production of insulin using rDNA technique was getting insulin assembled into a mature form.
Thus (c) is correct option.

45. ..... is the collection of methods that allows correction of gene defects diagnosed in a child or embryo.
(a) Genetic therapy (b) Gene therapy
(c) Molecular diagnosis (d) ELISA

Ans : COMP 2016
Gene therapy is a collection of methods that allows the correction of genetic defects diagnosed in a child or embryo. The defective mutant allele or non-functional gene is replaced, by functional gene.
Thus (b) is correct option.

46. Treatment of a genetic disorder by manipulating genes is called
(a) gene therapy
(b) gene replacement therapy
(c) bone marrow transplantation
(d) enzyme replacement therapy

Ans : OD 2006
Treatment of a genetic disorder by manipulating genes is called gene therapy.
Thus (a) is correct option.

47. First time the gene therapy was tried on a 4 years old girl in 1990 to treat which of the following enzyme deficiency?
(a) Cytosine Deaminase (CDA)
(b) Adenosine Deaminase (ADA)
(c) Tyrosine oxidase
(d) Glutamate trihydrogenase

Ans : COMP 2020
For the first time in 1990, M Blease and WF Andresco of National Institute of Health, attempted gene therapy on a 4 year old girl with Adenosine Deaminase (ADA) deficiency. ADA is caused due to the deletion of gene for adenosine deaminase.
Thus (b) is correct option.

48. Adenosine Deaminase (ADA) deficiency can be treated by $...A...$ and $...B...$ but it is not fully curative. Here A and B can be
(a) A-gene therapy, B-radiation therapy
(b) A-bone marrow transplantation, B-enzyme replacement therapy
(c) A-organ transplantation, B-hormone replacement therapy
(d) A-radiation therapy, B-enzyme replacement therapy

Ans : DELHI 2018
In some cases, adenosine deaminase deficiency can be cured by bone marrow transplantation and enzyme replacement therapy, but it is not fully curative.
Thus (b) is correct option.

49. A patient has a defective gene for the enzyme Adenosine Deaminase (ADA). He/She lacks functional cells and therefore, fails to fight the infecting pathogens. The cells are
(a) B-lymphocytes (b) phagocytes
(c) T-lymphocytes (d) Both (a) and (c)

Ans : SQP 2011
The SCID patient has a defective gene for the enzyme Adenosine Deaminase (ADA), which is involved in maturation of B and T-lymphocytes. He/She lacks functional lymphocytes and therefore, fails to fight the infecting pathogens.
Thus (d) is correct option.

50. PCR is used to
(a) detect HIV in suspected AIDS patients
(b) detect mutations in the genes in suspected cancer patients
(c) diagnose many genetic disorders
(d) All of the above

Ans : FOREIGN 2020
PCR can detect very low amounts of DNA. PCR is now usually used to detect HIV in suspected AIDS patients. It is also used to detect mutations in the genes of suspected cancer patients. It is a good technique to identify many other genetic disorders also.
Thus (d) is correct option.

51. A functional ADA cDNA can be introduced into the stem cells of the patients receiving gene therapy by using vector
(a) E.coli (b) Retrovirus
(c) Bacillus thuringiensis (d) Agrobacterium

Ans : FOREIGN 2005
A functional ADA cDNA can be introduced into stem cells of the patients receiving gene therapy by using retroviral vector.
Thus (b) is correct option.

52. What might be an advantage of beginning gene therapy prior to birth?
(a) This would give the body plenty of time
(b) The body would not reject it as it has not yet recognised 'self'

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70. The decisions regarding the validity of GMO (Genetic Modification of Organism) research and the safety of introducing GM organisms and their product for the public services in India is taken by
(a) Genetic Engineering Approval Committee
(b) Department of Recombinant DNA Technology
(c) Department of Science and Biotechnology
(d) National Biotechnology Board

Ans : **COMP 2020**
The decisions regarding the validity of GMO (Genetic Modification of Organism) research and the safety of introducing GM organisms and their products for public service in India is taken by Genetic Engineering Approval Committee.
Thus (a) is correct option.

71. Basmati is unique for its aroma and flavour, whose A ... varieties are cultivated in B ... .
Here A and B refers to
(a) A-27; B-America (b) A-30; B-America
(c) A-27; B-India (d) a-30; B-India

Ans : **OD 2019**
Basmati is unique for its aroma and flavour, whose 27 documented varieties are cultivated in India.
Thus (c) is correct option.

72. Which Indian plants have either been patented or attempts have been made to patent them by Western nations for their use?
(a) Basmati rice (b) Turmeric
(c) Neem (d) All of these

Ans : **FOREIGN 2005**
The patents have been taken out on the plants such as Basmati rice (Oryza sativa), black pepper (Piper nigrum), pomegranate (Punica granatum), Indian mustard (Brassica compestris), turmeric (Curcuma longa) and neem (Azadirachta indica). US, Japanes and German companies are the principal patenting pirates.
Thus (d) is correct option.

73. Which of the following statement is not of bioethical concerns?
(a) Biotechnology may pose unforeseen risks to biodiversity
(b) For commercial obtainment of transgenic product, animals are reduced to more factories.
(c) Both (a) and (b)
(d) None of the above

Ans : **OD 2008**
Bioethics refers to standards used to regulate the human activities in relation to the biological world.
Thus (d) is correct option.

74. Biopatent means
(a) right to use an invention
(b) right to use biological resources
(c) right to use applications
(d) right to use processes

Ans : **DELHI 2015**
Biopatent is a government protection granted for biological entities and their products. It gives protection to inventions, processes or products obtained along with the right to make and sell or use the product or processes for limited period of time.
Thus (b) is correct option.

75. A monopoly granted to a person who has either invented a new and useful article, made improvement in an existing article or invented a new process of making an article is called
(a) bioethics (b) patent
(c) biopiracy (d) genetic recombination

Ans : **SQP 2011**
A monopoly granted to a person who has either invented a new and useful article, made improvement in an existing article or invented a new process of making an article is called patent.
Thus (b) is correct option.

76. Biopiracy is related to which of the following?
(a) Traditional knowledge
(b) Biomolecules and regarding bioresources
(c) Bioresources
(d) all of the above

Ans : **COMP 2009**
Biopiracy involve exploiting and patenting another's knowledge or use of biological resources without proper authorisation.
Thus (d) is correct option.

77. Which step has been taken by Government of India to cater to the requirements of patent terms and other emergency provisions in this regards?
(a) Biopiracy act (b) Indian patents bill
(c) Biowar act (d) Bioethics act

Ans : **DELHI 2020**
Some nations are developing laws to prevent such unauthorised exploitation of their bioresearch and traditional knowledge. To check these problems, Indian parliament has recently cleared the second

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amendment of the Indian Patents Bill, that takes such issues into consideration.
Thus (b) is correct option.

ASSERTION AND REASON

DIRECTION : Each of these questions contains as Assertion following by Reason. Read them carefully and answer the question on the basis of following options. You have to select the one that best describes the two statements.

78. Assertion : Insect resistant transgenic cotton has been produced by inserting Bt gene.
Reason : The Bt gene is derived from a bacterium.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans :
Bt-cotton is a transgenic crop. Transgenic plants are those plants, which have foreign gene incorporated in their DNA. This insect resistant gene is derived from a bacterium, Bacillus thuringiensis.
Thus (b) is correct option.

79. Assertion : Agrobacterium tumefaciens is popular in genetic engineering because this bacterium is associated with roots of all cereals and pulse crops.
Reason : A gene incorporated in the bacterial chromosomal genome gets automatically transferred to the crop with which the bacterium is associated.
(a) If both Assertion and Reason are true and Reason is correct explanation of Assertion.
(b) If both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.
(c) If Assertion is true, but Reason is false.
(d) If both Assertion and Reason are false.

Ans :
Agrobacterium tumefaciens infects certain plants, in which Ti-plasmid causes the formation of tumour like growth called an s crown gall. Agrobacterium does not infect grasses.
Thus (d) is correct option.

80. Assertion : A crop expressing a cry gene is usually resistant to a group of insects.
Reason) : Cry proteins produced from Bacillus thuringiensis is toxic to larvae of certain insects.
(a) If both Assertion and Reason are true and Reason is correct explanation of Assertion.
(b) If both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.
(c) If Assertion is true, but Reason is false.
(d) If both Assertion and Reason are false.

Ans :
Bacillus thurinsiensis, a soil bacterium produces a Cry protein which is toxic to the larvae of certain insects. There are several kinds of Cry proteins. Each Cry protein is toxic to a different group of insects. The gene encoding Cry protein that is Cry gene has been isolated and transferred into several crops. A crop expressing a Cry gene is usually resistant to the groups of insects.
Thus (b) is correct option.

81. Assertion : The ADA gene provides instruction for producing the enzyme adenosine deaminase.
Reason : This enzyme is found throughout the body but is most active in lymphocytes.
(a) If both Assertion and Reason are true and Reason is correct explanation of Assertion.
(b) If both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.
(c) If Assertion is true, but Reason is false.
(d) If both Assertion and Reason are false.

Ans :
The ADA gene provides instructions for producing the enzyme adenosine deaminase. This enzyme is produced in all cells, but the highest levels of adenosine deaminase occur in immune system cells called lymphocytes, which develop in lymphoid tissues. Lymphocytes form the immune system, which defends the body against potentially harmful invaders, like viruses or bacteria.
Thus (b) is correct option.

82. Assertion : Due to excessive synthesis of gene for adenosine deaminase ADA disorder is caused.
Reason : If affects the human digestive system.
(a) If both Assertion and Reason are true and Reason is correct explanation of Assertion.
(b) If both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.
(c) If Assertion is true, but Reason is false.

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(d) If both Assertion and Reason are false.

Ans :
The ADA disorder is caused because of lack of gene for adenosine deaminase. It actually affects the human immune system (not digestive system). Thus (d) is correct option.

83. **Assertion :** To cure SCID, the first clinical gene theraphy for ADA was given.
Reason : Using retroviral vector the normal gene Was delivered into the patient's cells.
(a) If both Assertion and Reason are true and Reason is correct explanation of Assertion.
(b) If both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.
(c) If Assertion is true, but Reason is false.
(d) If both Assertion and Reason are false.

Ans :
SOD (Severe Combined Immuno-deficiency disease) is an immune disorder caused due to ADA (adenosine deaminase) deficiency. To cure SCID, the first gene theraphy was done and the normal gene was introduced using retroviral vector.
Thus (b) is correct option.

VERY SHORT ANSWER QUESTIONS

84. Tobacco plants are damaged severely when infested with Meloidogyne incognita. Name and explain the strategy that is adopted to stop this infestation.

Ans : **FOREIGN 2019**
Gene expression can be controlled by using RNA molecule and this technology is called RNA interference or RNAi or gene silencing. During this process nematode specific gene is introduced into host plant (using Agrobacterium) which produces dsRNA. This silences specific mRNA of the nematode and parasite dies.

85. Name the vector used for introducing the nematode specific gene in tobacco plant.

Ans : **COMP 2005**
Agrobacterium tumifaciens.

86. State the role of DNA ligase in biotechnology.

Ans : **OD 2009**
DNA ligase joins the DNA fragments with same sticky ends/Link Okazaki fragments or discontinuously synthesised fragments/Link desired gene with plasmid to form recombinant DNA. (any one)

87. What happens when Meloidegyne incognitia consumes cells with RNAi gene?

Ans : **DELHI 2015**
The specific mRNA of the nematode is silenced and the parasite dies.

88. How do organic farmers control pests? Give two examples.

Ans : **SQP 2020**
By natural predation or biological control.
Examples: Lady bird used to kill aphids, dragon files used to kill mosquitoes, Bacillus thuringiensis used to kill cotton bollworm.

89. What is plasmid?

Ans : **FOREIGN 2012**
Plasmid is a circular extra-chromosomal DNA molecule present in a bacterial cell, which replicates autonomously independent of bacterial chromosomal DNA.

90. How are these proteins useful in agriculture?

Ans : **OD 2005**
These Cry proteins are toxic to certain larvae of insects and thus provide resistance against them. The gene encoding Cry proteins are used in several crop plants (Bt toxin). Such a crop plant is resistant to the particular insect pest.

91. What do the differently written terms 'Cry' and 'cry' represent respectively?

Ans : **DELHI 2013**
Cry represents crystal protein while cry refers to the gene encoding the Cry protein.

92. Give the scientific name of the soil bacterium which produces crystal (Cry) proteins.

Ans : **COMP 2016**
Bacillus thuringiensis.

93. Name the source from which insulin was extracted earlier. Why is this insulin no more in use by diabetic people?

Ans : **SQP 2011**
Earlier, insulin was extracted from pancreas of slaughtered cattle and pig. This insulin is not in use as some patients developed allergic reaction to this foreign protein.

94. How is the insulin produced by human body different from the insulin produced by the above mentioned company?

Ans : **FOREIGN 2015**
The pro-hormone produced in the human body has an extra stretch of C-peptide.

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95. Why are transgenic animals so called?

Ans : **COMP 2005**

Transgenic animals are those that have had their DNA manipulated to possess and express an extra/foreign gene e.g., Transgenic rats, rabbits, pigs, sheep, cow, fish and mice.

96. What are transgenic plants?

Ans : **OD 2020**

Transgenic plants are genetically modified plants that contain and express one or more foreign genes.

97. What is a transgene?

Ans : **DELHI 2010**

Transgene is a foreign gene that is inserted in an organism/plant to modify its expression.

98. What are cry genes? In which organisms are they present?

Ans : **OD 2017**

Cry genes are the genes found in 'Bacillus thuringiensis' a bacterium. These genes encode for protein crystals that contain a toxic insecticidal protein called Bt toxin

99. Name the nematode that infects the roots of tobacco plants. Also, name the vector used to introduce nematode specific genes.

Ans : **SQP 2011**

Nematode - Meloidegyne incognita
Vector - Agrobacterium.

100. State the role of C-peptide in human insulin.

Ans : **OD 2014**

C-peptide is an extra stretch of polypeptide which makes the insulin molecule inactive.

101. State the significance of the process of RNA interference (RNAi) in eukaryotic organisms.

Ans : **FOREIGN 2020**

RNA interference (RNAi) acts as cellular defence in all ettkaryotic organisms.

102. State the role of transposons in silencing of mRNA in eukaryotic cells.

Ans : **OD 2013**

Transposons are the source of complementary RNA that binds to and prevents the translation of specific rnRNA.

103. A multinational company outside India tried to sell new varieties of turmeric without proper rights. What is such an act referred to?

Ans : **OD 2008**

Biopiracy

104. How is biotechnology useful in increased insulin production to benefit needy people?

Ans : **COMP 2005**

Biotechnology is helpful by producing genetically engineered bacteria which are capable of producing insulin in culture

105. State the cause of adenosine deaminase enzyme deficiency.

Ans : **OD 2015**

The adenosine deaminase enzyme deficiency is caused by deletion of a gene for ADA, an enzyme crucial for the immune system to function.

106. Suggest any two possible treatments that can be given to a patient exhibiting adenosine deaminase deficiency.

Ans : **OD 2015**

Bone marrow transplantation and enzyme replacement therapy.

107. Name the source organism from which Ti plasmid is isolated. Explain its uses in biotechnology.

Ans : **DELHI 2009**

Agrobacterium tumefaciens. It is used as vector for transferring gene of interest into host organism.

108. Why do children cured by enzyme- replacement therapy for adenosine deaminase deficiency need periodic treatment?

Ans : **OD 2015**

Children cured by enzme replacement therapy for adenosine deaminase deficiency need periodic treatment. It is because such type of treatment uses genetically engineered lymphocytes that are mortal.

109. List the diseases for which transgenic animals are being used for trials.

Ans : **SQP 2019**

Cancer, cystic fibrosis and Alzheimer's disease.

110. Which human protein is used to treat emphysema?

Ans : **FOREIGN 2011**

Human protein $\alpha - 1$ - antitrypsin

111. Mention the name of two common diseases that can be treated by medicines that contain biological products of transgenic animals.

Ans : **COMP 2005**

Phenylketonuria and cystic fibrosis.

112. Name any one diagnostic kits based upon antigen-antibody interaction.

Ans : **OD 2005**

ELISA

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113. Name a transgenic animal being used in testing the safety of polio vaccine.

Ans : DELHI 2009

Transgenic mice.

114. Name the bond which joins chains 'A' and 'B' in insulin.

Ans : SQP 2011

Peptide bond

115. What is a patent?

Ans : OD 2009

Patent is a set of exclusive rights granted by a government to investors to prevent others from commercial using their invention.

116. What is biopiracy?

Ans : DELHI 2017, FOREIGN 2015

Biopiracy refers to the use of bioresources by multinational companies and other organisations without proper authorisation from the countries and people concerned without any payment.

117. Name the Indian variety of rice patented by an American company.

Ans : COMP 2020

Basmati rice.

118. Name any two Indian traditional herbal medicines.

Ans : OD 2015

Turmeric and neem.

119. Bt toxin protein exists in which form inside bacterium?

Ans : DELHI 2011

Inactive form, i.e. protoxins.

120. Give specific content of milk produced by transgenic cow Rosie.

Ans : SQP 2010

It contains human alphalactalbumin, a more nutritionally balanced product for human babies.

121. Why biopiracy should be prevented?

Ans : FOREIGN 2006

Biopiracy should be prevented to stop the unauthorised exploitation of bioresources

122. What are transgenic animals? Give an example.

Ans : OD 2024, 2016

Animals with manipulated DNA to possess and express an extra (foreign) gene are known as transgenic animals, e.g. transgenic rats, rabbits, pigs, etc.

SHORT ANSWER QUESTIONS

123. What do you mean by genetically modified organism? Describe two benefits of these crops.

Ans : OD 2018

An organism that has been modified by the application of recombinant DNA technology is called as genetically modified organism (GMO). Such crops are better than local varieties as they confer resistance to viruses, insects, herbicides or post-harvest deterioration and accumulation of useful modified storage products. Important examples of GMO's are Bt cotton, Flavr savr tomato, golden rice etc.

124. What is micro propagation? What are the advantages of producing plants through this technique.

Ans : OD 2018

Micro propagation or clonal propagation is a technique is which any vegetative (meristmatic) part of plant (such as shoot tip) are excised aseptically and cultured on sterile media under controlled conditions to give rise to plant lets which are exact copy of its donor plant.

Advantages of micro propagation are as follows

(i) A large number of plants can be grown is short span of time.

(ii) Disease free or virus free plants can be obtained from infected plants species.

(iii) Seedless plants and plants with impotent seeds can be multiplied by this method.

125. Write benefits of transgenic animals.

Or

Describe the benefits of transgenic animals.

Ans : OD 2015, COMP 2012

A transgenic animal is one whose genome has been altered to carry genes from other species. The main benefits of production of transgenic animals are as follows:

(i) **Study of Normal Physiology and Development :** Transgenic animals can be specifically designed to allow the study of how genes are regulated and how they affect the normal functioning of the body and its development.

(ii) **Study of Disease :** Many transgenic animals are designed to increase the understanding of how genes contribute to the development of diseases such as cancer, cystic fibrosis, rheumatoid arthritis and Alzheimer.

(iii) **Vaccine Safety :** Transgenic mice are being used in testing the safety of vaccines before they are used in humans, e.g., polio vaccine.

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(iv) **Biological Products :** Transgenic animals that produce useful biological products can be created by the introduction of the portion of the DNA or genes that codes for a particular product such as human protein (alpha-1-antitrypsin) which is used to treat emphysema.

126. What is molecular diagnosis?

Ans : **OD 2014**

Molecular diagnostics is a collection of techniques used to analyse biological markers in the genome and proteome - the individual's genetic code and how their cells express their genes as proteins by applying molecular biology to medical testing. The technique is used to diagnose and monitor disease, detect risk and decide which will work best for individual patients. By analysing the specifics of the patient and their and their disease, molecular diagnostics offers the prospect of personalized medicine.

127. What are second generation vaccines?

Ans : **DELHI 2009**

With the help of genetic engineering, vaccines of immense importance are synthesized, called second generation vaccines. They consist of a few antigens present on the surface of the infecting agents rather than the whole inactivated organism (first generation vaccine). The surface antigens are produced in large quantities with the help of recombinant DNA technique. These vaccines are injected in safer, does to healthy individuals for development of immunity. They are more uniform in quality and have less side effects than first generations vaccines. For examples, vaccine for Hepatitis-B.

128. Tobacco plants are damaged severely when infested with Meloidegyne incognitia. Name and explain the strategy that is adopted to stop this infestation.

Ans : **SQP 2012**

Pest-resistant plants : Several nematodes parasites, a wide variety of plants and animals. A nematode Meloidegyne incognitia infects the roots of tobacco plants and reduces the yield.

Name of Strategy : A process RNA interference, prevents this infestation.

It is a method of cellular defence which takes place in all eukaryotic organisms. It involves silencing of a specific m-RNA due to the complementary ds-RNA molecule that binds to and prevents translation of m-RNA (silencing). In this the source of this complementary RNA could be from an infection by viruses having RNA genome or mobile genetic elements (transposons) that replicate via an RNA intermediate.

129. Name the vector used for introducing the nematode specific gene in tobacco plant.

Ans : **OD 2024, SQP 2010**

Using Agrobacterium vectors, nematode specific genes were introduced into host plant. The introduction of DNA produced both sense and antisense RNA in the host cells. These two RNAs being complementary to each other formed a ds-RNA that initiated RNAi and thus silenced the specific m-RNA of the nematode. As a result the parasite could not infest, multiply and survive in the absence of a gene product in a transgenic host expressing specific interfering RNA.

130. Write about the following:

(i) Monoclonal Antibody

(ii) Interferon

Ans : **OD 2014**

(i) Monoclonal Antibodies are the antibodies produced by a single clone of cells (cell lines) and consists of identical antibody molecules.

(ii) Interferons are glycoprotein molecules produced by eukaryotic cells in response to viral infections. They are cytokines with indirect and non specific antiviral activities.

131. Define DNA fingerprinting and mention two applications of DNA finger printing.

Ans : **OD 2014, FOREIGN 2009**

DNA fingerprinting is a technique used to identify and analyze the variations in various individuals at the level of DNA. It is a technique of determining nucleotide sequences of certain areas of DNA which are unique to each individual. Each person has a unique DNA fingerprint. It is based on variability and polymorphism in DNA sequences. Its various applications are :

(i) It is used in forensic science to identify potential crime suspects.

(ii) It is used to establish paternity and family relationships.

(iii) It is used to find out the evolutionary history of an organism and trace out the linkages between groups of various organisms.

132. What is gene therapy? Write in brief.

Ans : **OD 2014**

Gene therapy is a technique in which gene is inserted into individual's cells and tissue to treat a disease in which a defective mutant allele is replaced with functional one.

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The first gene therapy in human beings was given to a girl, named Ashanti De Silva, who suffered from a genetic condition called Severe Combined Immunodeficiency Disease (SCID).
This disorder is caused due to the deletion of the gene for Adenosine Deaminase (ADA). The mutant cell is unable to produce ADA.
Gene therapy can be divided into two categories:

(i) **Germ line gene therapy :** In this type of gene therapy, germ cells, i.e. sperms or eggs (even zygotes) are modified by the introduction of functional genes. These altered eggs are then re-implanted into the mother. This is an in vitro method that alter germ line cells. The changes produced are inheritable.

(ii) **Somatic gene therapy :** It involves changing some of the somatic cells (exclude germ cells) which are introduced into the patient. The changes produced are non-inheritable.

133. What do you understand by Bt-cotton?

Ans : **OD 2012**

Bt-cotton is an insect-resistant transgenic crop designed to combat the bollworm. Bt-cotton was created by genetically altering the cotton genome to express a microbial protien from the bacterium Bacillus thuringiensis. In short, the transgene inserted into the plant's genome produces toxin crystals that the plant would not normally produce which, when ingested by a certain population or organisms, dissolves the gut lining, leading to the organism's death.

134. Mention two applications of biotechnology in the field of medicine.

Ans : **OD 2009**

Two applications of biotechnology in the field of medicine are as follows :

(i) **Gene Therapy :** Gene therapy is a collection of methods that allows correction of genetic defect that has been diagnosed in a child/ embryo. In it, faulty gene is replaced by a normal healthy functional gene.

(ii) **Vaccine production :** The production of vaccines against viruses, such as the herpes and hepatitis virus (second generation vaccines) involves the use of genetic engineering. Genes that code for part of the protein or polysaccharide coat of the herpes simplex virus or the hepatitis-B virus are inserted into vector such as vaccinia virus and then transferred into cultured mammalian cells that Generate numerous copies of the recombinant virus, which has the outside coat of a herpes or hepatitis virus.

135. What is GEAC and what are its objectives?

Or

Describe the responsibility of GEAC, set up by the Indian Government.

Ans : **COMP 2011**

GEAC (Genetic Engineering Approval Committee) is an Indian government organisation. Its objective are to:

(i) examine the validity of GM (Genetic modification of organism) research.

(ii) inspect the safety of introducing GM for public services and for their large scale use.

136. Highlight any four advantages of genetically modified organisms (GMOs).

Ans : **OD 2005**

Advantages of GMOs are as follows :

(i) tolerance against abiotic stresses (cold, drought, salt, heat).

(ii) reduces reliance on chemical pesticides.

(iii) reduces post-harvest losses.

(iv) increase efficiency of mineral usage by plants.

137. How has recombinant technology helped in large scale production of vaccines? Explain giving one example.

Ans : **DELHI 2011**

Production of insulin by rDNA techniques was achieved by an American company, Eli Lilly, in 1983. It prepared two DNA sequences corresponding to A and B chains of human insulin and introduced them in plasmids of E.coli for production. The A and B chains produced were separated, extracted and combined by creating disulfide bonds to form human insulin.

138. Why do the toxic insecticidal proteins secreted by Bacillus thuringiensis kill the insect and not the bacteria itself?

Ans : **SQP 2010**

The Bt toxin protein exists as inactive protoxins but once an insect ingests the inactive toxin, it is converted into an active form of toxin due to the alkaline pH of the gut which solubilise the crystals. Therefore, it does not kill the bacteria.

139. Name the genes responsible for making Bt cotton plants resistant to bollworm attack.
How do such plants attain resistance against bollworm attacks? Explain.

Ans : **FOREIGN 2005**

Bt cotton has cryIAc/cryIIAb genes. These genes produce crystals of protoxin.
When bollworm bites the cotton fruits, it consumes

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(ii) nature of the host cell.

165. Mention some transgenic plants and their potential applications.

Ans : FOREIGN 2012

Some transgenic plants and their potential applications are given below:

	Transgenic plants	Useful applications
1.	Flavr Savr tomato	Better nutrient quality.
2.	Brassica napus	Contains hirudin (a protein) that prevents blood clotting. Hirudin is synthesised chemically and it is transferred into Brassica napus.
3.	Bt cotton	It has resistance to bollworm infestation, tolerance to herbicide, high yielding.
4.	Wheat	Resistant against herbicide PPT (Commercial name "Basta" - 26 percent PPT).
5.	Potato	Content of starch increased by about 20-40 percent.
6.	Corn, brinjal	Insect resistance.
7.	Maize, soyabean	Herbicide resistance.
8.	Golden rice	Rich in vitamin-A

166. Biotechnology has helped farmers to get pest resistance cotton crops. Explain the technique adopted along with its mode of action. (Mention six points).

Ans : OD 2020

The technique involves the use of a popularly known biopesticides Bt toxin produced by bacteria Bacillus thuringiensis. Bt toxin protein when ingested by the insect gets converted to its active form due to alkaline pH of the gut. The activated toxin binds to the surface of midgut epithelial cells. It creates pores in these cells that cause swelling and lysis and eventually kills the insect. The genes (cry genes) encoding this protein encoded by these cry genes control the pest. Specifically, cryIAc and cryIIAb control cotton bollworm (Helicoverpa armigera), an insect belonging to Lepidoptera which earlier used to destroy the whole crop.

167. What is meant by ADA deficiency? How is gene therapy a solution to this problem? Why is it not a permanent cure?

Ans : SQP 2013

(a) Gene therapy is a collection of methods that allows correction of gene defects, diagnosed in a child or embryo.

(b) By insertion of normal genes, the defective mutant allele of the genes are replaced and non-functional gene is compensated.

(c) For the first time in 1990, M.Blease and W.F. Andresco of National Institute of Health, attempted gene therapy on a 4 years old girl with adenosine deaminase (ADA) deficiency.

(d) ADA is caused due to deletion of gene for adenosine deaminase.

(e) In some cases, it can be cured by bone marrow transplantation and enzyme replacement therapy but it is not fully curative.

(f) Lymphocytes from patient's blood were grown in a culture and functional ADA, cDNA was introduced in these lymphocytes using a retroviral vector.

(g) The lymphocytes were transferred into the patient's body. Periodic infusion of such genetically engineered lymphocytes is done because these cells are mortal.

(h) For permanent cure, gene isolated from the bone marrow cells producing ADA, at early embryonic stage can be a possible cure.

(i) Other diseases like cystic fibrosis, haemophilia, cancer, Parkinson's, etc., are also treated by gene therapy.

168. How does a transgenic organism differ from the rest of its population? Give any two examples of such organism for human advantage.

Ans : DELHI 2016

A transgenic organism contains foreign gene, hence it differs from the rest of the population in having one or more extra genes apart from the gene pool of that population showing an additional phenotype.

Example,

(i) Transgenic E.coli, with gene for human insulin.

(ii) Transgenic mouse with gene for human growth hormone.

169. What do you understand by the term biopesticide? Name and explain the mode of action of a popular biopesticide. Biopesticides are methods of controlling pests that rely on natural predation

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protein; the Bt toxin protein exists as an inactive protein, but once an insect ingests it, it gets converted into an active form due to the alkaline pH of the gut which solubilises the crystal. The activated toxin binds to the surface of mid gut and creates pores that cause swelling, lysis and eventually death of the insects.

146. What are the conditions for which patents is given?

Ans : **OD 2019**

Patent is given for:

(i) producing new products or inventions.

(ii) modification and improvement of earlier inventions.

(iii) technical know-how.

(iv) designing of new concepts.

147. Differentiate between gene therapy and gene cloning

Ans : **DELHI 2016**

The difference between gene therapy and gene cloning is as follows :

Gene therapy	Gene cloning
The process of replacing defective gene responsible for hereditary disease by the normal gene is called gene therapy.	The technique to produce identical copies of a particular segment of DNA or a gene.

148. Expand GMO. How is it different form a hybrid?

Ans : **FOREIGN 2006**

GMO stands for genetically modified organism. It differs from a hybrid because in a hybrid, cross is done between total genomes of two species or strains, whereas in a GMO, foreign genes are introduced in the organism and is usually maintained as extra-chromosomal entity or is integrated into the genome of the organism and their is change in only one phenotype.

149. Mention the problems when we consume GM food.

Ans : **OD 2008**

When we consume GM food, following problems arise:

(i) GM food may cause toxicity.

(ii) The bacteria present in the alimentary canal of human could take up the antibiotic resistant gene which is present in GM food, that will cause problem.

150. How is PCR used to detect gene mutation is case of suspected cancer patient?

Ans : **SQP 2014**

A single stranded small DNA or RNA is tagged with radioactive molecule to be used as a probe. The probe is hybridised with DNA in cancer cells to be followed by autoradiography. The clone with mutated gene will not appear in the autoradiography, because the probe will not have the complementary sequence with mutated gene.

151. Name the process involved in the production of nematode-resistant tobacco plants, using genetic engineering. Explain the strategy adopted to develop such plants.

Ans : **SQP 2005**

The process involved in the production of nematode-resistant plants is RNA interference or RNAi. Using Agrobacterium vectors, nematode-specific genes were introduced into the host plant. The introduction of DNA was such that it produced both sense anti sense RNA in the host cells. These two RNA's being complementary to each other formed a double stranded RNA (dsRNA) that initiated RNAi and thus, silenced the specific mRNA of the nematode. The consequence was that the parasite could not survive in a transgenic host expressing specific interfering RNA. The transgenic plant, therefore, got itself protected form the parasite.

152. Describe the various stages involved in gene transfer for the commercial production human insulin by Eli Lilly.

Ans : **COMP 2009**

(i) Eli Lilly prepared two DNA sequences corresponding to the A and B chains of human insulin.

(ii) Sticky ends were produced in the Escherichia coli plasmid and the insulin gene by treating them both with the same restriction endonucleases.

(iii) These two are then joined together by the enzyme DNA ligase.

(iv) The bacteria are then grown in sterilised bioreactors in the appropriate growth medium.

(v) The chain A and B are produced separately, extracted the purified.

(vi) These two chains are then combined by creating disulfide bonds to form human insulin.

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the toxic insecticidal protein. The alkaline pH in its gut activates the toxin. The activated toxin binds to mid-gut epithelial cells resulting in the lysis of cell leading to the death of the insect.

140. Nematode-specific genes are introduced into the tobacco plants using Agrobacterium vectors to develop resistance in tobacco plants gainst nematodes. Explain the events that occur in tobacco plant to develop resistance.

Or

How was RNAi technique helped to prevent the infestation of roots in tobacco plants by a nematode Meloidegyne incognitia?

Ans : **COMP 2020**

(i) A nematode Meloidegyne incognitia infects the roots of tobacco plants which reduces the production of tobacco.

(ii) It can be prevented by using RNA interference (RNAi) process which is checked by silencing of specific mRNA due to complementary dsRNa.

(iii) dsRNA binds and prevents translation of mRNA (silencing).

(iv) By using Agrobacterium vectors, nematode-specific genes were introduced into the host plants which produce both sense and anti-sense RNA in the host cells.

(v) These two RNas are complementary to each other and form a double-started RNA (dsRNA) that initiates RNAi and hence silence the specific mRNA of the nematode.

(vi) The parasite cannot survive in the transgenic host, so protects the plants from pests.

141. Write the functions of adenosine deaminase enzyme. State the cause of ADA deficiency in humans. Mention a possible permanent cure for a ADA deficiency patient.

Ans : **DELHI 2016**

Adenosine deaminase enzyme is responsible for the proper functioning of the immune system. ADA deficiency is caused by deletion of gene for adenosine deaminase. A possible permanent cure would be gene therapy, if it is detected at early embryonic stage.

142. Why is the functional insulin thus produced considered better than the ones used earlier by diabetic patients?

Ans : **COMP 2018**

The insulin prepared by rDNA technology does not produce sensitive allergic reactions and immunological reactions whereas those used earlier produced allergic reactions and other complications to the foreign protein as earlier they were extracted from pancreas of slaughtered cattle or pigs.

143. What is Biopiracy? State the initiative taken by the Indian Parliament towards it.

Ans : **OD 2015**

Biopiracy is the use of bioresources by organisations withour proper authorisation from the countries and people concerned without compensatory payment.

The government has cleared patent terms, emergency provisions and research and development initiative.

Biopiracy is defined as the use of bioresources by multinational companies and other organisations, without proper authorisation from the countries and concerned people, without compensatory payment.

Generally, financially rich nations are poor in biodiversity and traditional knowledge, while developing and under-developed nations are rich in biodiversity and traditional knowledge, related to bioresources.

Traditional knowledge related to bioresources can be exploited to develop modern applications and are used to save time, efforts and expenditure during their commercialisation.

Some nations are developing laws, to prevent such unauthorised exploitation of their bioresources and traditional knowledge.

To check these problems, Indian Parliament has recently cleared the second amendment of the Indian Patents Bill, that takes such issues into consideration.

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144. Name the biological products made in transgenic animal to treat emphysema. Explain.

Ans : **SQP 2007**

Human protein α-1-antitryspin is produced to treat emphysema. The gene for this protein is isolated and introduced into a mouse. The transgenic mouse produces the protein, which is to be isolated, purified and used on human beings after further clinical trials.

145. cryIAb is introduced in a plant to control infestation by corn borer.

(i) Name the resultant plant after successful insertion of the gene desired.

(ii) Summarise the action of the gene introduced.

Ans : **FOREIGN 2005**

(i) Bt corn

(ii) CryIAb/Bt toxin gene codes for crystal

creating disulfide bonds to form human insulin. Insulin in human pancreas is synthesised as a pro-hormone containing the C peptide, which is removed to form mature hormone. The synthesised insulin did not contain C peptide and was directly prepared in mature form.

160. List the three molecular diagnostic techniques that help detect pathogens from suspected patients. Mention one advantage of these techniques over conventional methods.

Ans : COMP 2005

The three molecular diagnostic techniques that help to detect pathogens from suspected patients are:

(i) Recombinant DNA technology

(ii) polymerase chain reaction (PCR)

(iii) Enzyme-linked immunosorbent assay (ELISA)

These techniques are better than the conventional methods because they help in early diagnosis of the disease even when the bacteria or virus concentration is very low.

161. Recombinant DNA-technology is of great importance in the field of medicine. With the help of a flow chart, show how this technology has been used in preparing genetically engineered human insulin.

Ans : OD 2018

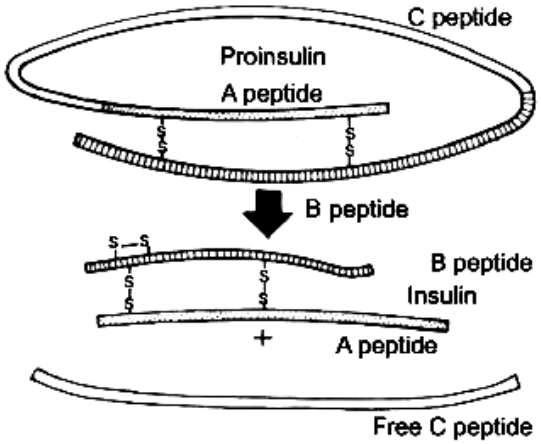
(i) Insulin contains two short polypeptide chains-chain A and Chain B linked by disulphide bridges.

(ii) In mammals, insulin is synthesised as a pro-hormone (that needs to be processed to become mature and functional hormone). It contains an extra stretch called C peptide,

(iii) C peptide is absent in mature insulin and is removed during maturation into insulin.

(iv) Earlier, insulin was extracted from pancreas of slaughtered cattle and pigs but some patients began developing allergies.

(v) Production of insulin by rDNA techniques was achieved by an American company, Eli Lilly, in 1983. It prepared two DNA sequences corresponding to A and B chains of human insulin and introduced them in plasmids of E.coli for production. The A and B chains produced, were separated, extracted and combined, by creating disulfide bonds to form human insulin.



162. Plasmid is a boon to biotechnology. Justify this statement quoting the production of human insulin as an example.

Ans : COMP 2019

Plasmids are extra chromosomal, self-replicating, usually circular, double stranded DNA molecules found naturally in many bacteria.

In 1983, Eli Lilly an American company, first prepared two DNA sequences corresponding to A and B chains of human insulin and introduced them in plasmids of E.coli to produce insulin chains. These chains A and B were produced separately, extracted and combined by creating disulfide bonds to form functional human insulin (humulin).

163. How did the process of RNA interference help to control the nematode from infecting roots of tobacco plants? Explain.

Ans : DELHI 2011

Using Agrobacterium vectors, nematode specific genes are introduced into host plant. The introduction of DNA produced both sense and anti sense RNA in host cells. These two RNA's being complementary formed a double stranded RNA (dsRNA) that initiated RNAi and silenced the specific nRNA of the nematode. As a result, the parasite could not survive in the transgenic host expressing specific interfering RNA.

164. What are genetically modified organisms? Name two factors on which their behaviour depends?

Ans : SQP 2015

Plants, fungi, bacteria and animals that have had their DNA manipulated to posses and express an extra (foreign)gene are known as genetically modified organisms.

The two factors on which the behaviour of such organisms depend are:

(i) nature of gene transferred.

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153. Expand the name of the enzyme ADA. Why is this enzyme essential in the human body? Suggest a gene therapy for its deficiency.

Ans : **DELHI 2012**

ADA-Adenosine deaminase:

This enzyme is essential for immune system to function. ADA deficiency can be cured by gene therapy. Lymphocytes from the blood of the patients are extracted and cultured outside the body. A functional ADA cDNA (using a retroviral vector) is introduced into these lymphocytes and these lymphocytes are then returned to the patient's body. However, as these cells are not immortal, the patient requires periodic infusion of such genetically engineered lymphocytes.

154. (i) Name the deficiency for which first clinical gene therapy was given.

(ii) Mention the causes of and one cure for this deficiency.

Ans : **FOREIGN 2005**

(i) Adenosine deaminase deficiency (ADA).

(ii) **Cause :** Deletion of ADA gene.

Cure : Bone marrow transplantation/enzyme replacement therapy/enzyme replacement therapy/giving functional ADA to patient by injection/infusion of genetically engineered lymphocytes/introducing gene isolated from marrow cells producing ADA into cells at early embryonic stages. (Any one)

155. Explain enzyme-replacement therapy to treat adenosine deaminase deficiency. Mention two disadvantages of this procedure.

Ans : **COMP 2008**

Functional adenosine deaminase is given to the patient by injection.

(i) Lymphocytes from the blood of the patient are grown on culture outside the body.

(ii) A functional ADA, cDNA is then introduced into these lymphocytes using a retroviral vector.

(iii) The genetically engineered lymphocyte are returned to the blood of patient.

Disadvantages : Therapy is not completely curative as cells do not remain alive and periodic infusion of lymphocytes is required.

156. State the difference in their approach from that of conventional pest control methods.

Ans : **SQP 2020**

The difference between conventional pest control and organic farming based pest control are as follows :

	Conventional pest control	**Organic farming based pest control**
1.	Use of chemical insecticides and pesticides.	No chemical used.
2.	Harmful to non-target organisms.	Not harmful to non-target organisms.
3.	Cause environmental pollution.	No adverse impact on environment.

157. Why do lepidopterans die when they feed on Bt cotton plants? Explain how does it happen.

Ans : **FOREIGN 2006**

Bt cotton contains inactive toxin protein or protoxin. These are insecticidal protein in the form of crystal protein. Once the insect ingests its the inactive protoxins is converted into active form due to alkaline pH in the gut, which solubilise the crystals. The activated toxins bind to the surface of midgut epithelial cells, thus creating pores which causes cell swelling and lysis, eventually leading to the death of the insect pest.

158. Name the pest that destroys the cotton bolls. Explain the role of Bacillus thuringiensis in protecting the cotton crop against the pest to increase the yield.

Ans : **OD 2013**

Cotton bollworms destroy the cotton bolls. Bacillus thuringienesis has Bt toxin genes. These genes produce toxic proteins that kill the pest. Bt toxins are initially inactive protoxins but after ingestion by the insect their inactive toxin becomes active due to the alkaline pH of the gut. The activated toxin binds to the surface of midgut epithelial cells thus killing the insects. Specific Bt toxins were isolated from Bacillus thuringienesis and incorporated into the cotton plants to make them pest resistant.

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159. How did Eli Lilly synthesise the human insulin? Mention one difference between this insulin and the one produced by the human pancreas.

Or

How did Eli Lilly company go about preparing the human insulin? How is the insulin thus produced different from that produced by the functional human insulin gene?

Ans : **DELHI 2019**

Eli Lilly prepared two DNA sequences corresponding to A and B chains of human insulin and introduced them in plasmids of E.coli to produce insulin chains. Chains A and B were produced separately, extracted and combined by

rather than introduced chemicals/or living organisms used to kill pests.

Ans : **FOREIGN 2016**

Biopesticide is a pesticide which is:

(i) not chemical in nature.

(ii) more specific in action against the pest.

(iii) safer for environment than chemical pesticides.

A popularly known biopesticide is Bt toxin, which is produced by a bacterium called Bacillus thuringiensis. Bt toxin gene has been cloned from this bacterium and expressed in plants. Bt toxin protein when ingested by the insect, gets converted to its active form due to the alkaline pH of the gut. The activated toxin binds to the surface of midgut epithelial cells and create pores that cause cell swelling and lysis and eventually kills the insect.

170. Explain the process of synthesis of insulin by Eli Lilly company. Name the technique used by the company.

Ans : **DELHI 2019**

Eli Lilly used the following procedure for insulin synthesis:

(a) Two DNA sequences corresponding to A and B chains of insulin were prepared.

(b) These sequences were then introduced in plasmids of E.coli.

(c) The two insulin chains are produced separately.

(d) The two chains are extracted and combined by creating disulphide bonds to form the assembled mature molecule of insulin.

171. (i) Why is Bacillus thuringiensis considered suitable for developing GM plants?

(ii) Explain how it has been used to develop GM crops.

Ans : **SQP 2005**

(i) Some strains of Bacillus thuringiensis produce proteins that kill some insects like lepidopterans (tobacco budworm, armyworm), coleopterans (beetles) and dipterans (flies, mosquitoes). Bt toxins are initially inactive protoxins but after ingestion by the insect their inactive toxin becomes active due to the alkaline pH of the gut which solublise the crystals. The activated toxin binds to the surface of midgut epithelial cells thus swelling and lysis, further leading to death of the insects.

(ii) Bacillus thuringiensis produces Cry protein. Cry protein producing gene is transferred to the plant to provide resistance against insect larvae. Man has developed several transgenic crops by introducing these genes from bacteria to crop plants such as Bt cotton, Bt corn. etc.

172. Explain the different uses of biotechnology in medical field.

Ans : **FOREIGN 2015**

The different uses of biotechnology in medical field area as follows :

(i) The recombinant DNA technology is used for production of therapeutic drugs which are safe and effective.

(ii) About thirty recombinant therapeutics have been approved from human use in the world including India.

(iii) The genetically engineered insulin helps in maintaining the glucose-glycogen balance in the body.

(iv) Gene therapy treatment is used in the defective heredity by introduction of normal healthy and functional genes.

(v) It is used in the treatment of disease like cystic fibrosis, haemophilia, AIDS, cancer, Parkinoson's, etc.

(vi) Due to advancement in the field of biotechnology, it is now possible to develop recombinant vaccines with specific actions and less side effects.

(vii) Also, monoclonal antibodies are produced with high specificity for specific antigens and are ideal for diagnosis of specific diseases. One of the major role of these monoclonal antibodies is immune suppression for kidney transplantation.

173. How have pest-resistant plants been produced using biotechnology? Explain.

Ans : **COMP 2016**

(i) A nematode Meloidegyne incognitia infects the roots of tobacco plants which reduces the production of tobacco.

(ii) It can be prevented by using RNA interference (RNAi) process which is checked by silencing of specific mRNA due to complementary dsRNa.

(iii) dsRNA binds and prevents translation of mRNA (silencing).

(iv) By using Agrobacterium vectors, nematode-specific genes were introduced into the host plants which produce both sense and anti-sense RNA in the host cells.

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biotechnology tools like Enzymes Linked Immuno-sorbant Assay (ELISA), PCR based technique and RIA Assays.

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181. What do you understand by 'micro-propagation'? Write the methods involved with suitable diagrams.

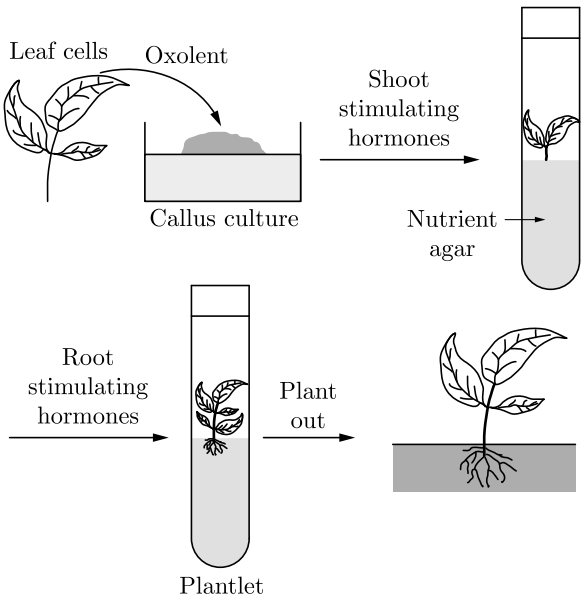
Or

Write an essay on tissue culture.

Ans : **OD 2015, FOREIGN 2011**

The production of new plants from special tissues in the synthetic nutritive medium containing plant nutrients and plant hormones is called tissue culture or micro propagation.

In this technique some plant cells or plant tissues are taken from the meristamatic regions of the plants and put into the culture solution taken in a beaker under favourable and controlled conditions. Culture solution is a special solution containing essential nutrients and plant hormones in which the tissues are grown. The plant cells grow rapidly in the culture medium and get converted into a group of cells called 'callus'. The callus thus produced is shifted in other beakers containing suitable hormones. These hormones induce the growth of root and shoot system in the callus. In this way the callus is converted into a tiny plantlet. This plantlet is then shifted in the soil where it grows into a full plant.



Advantages :

(i) It is a very fast technique.

(ii) New plant produced by tissue culture are disease free.

(iii) Very little space is needed.

(iv) By this method plants can be grown around the year irrespective of weather or seasons.

182. What do you mean by biotechnology? Explain its role in the field of agriculture.

Or

Write the role of biotechnology in agriculture.

Ans : **OD 2013, COMP 2009**

Plant breeding is the process in which two genetically dissimilar varieties are purposely crossed to produce a new hybrid variety. It is the science of changing the traits of plants in order to produce desired characteristics. As a result, characteristics from both parents can be obtained in the hybrid plant variety. Thus, it involves the production of a new variety with the desired characteristics such as resistance to diseases, climatic adaptability and better productivity. The various steps involved in development of disease resistant variety by plant breeding are as follows:

(i) **Collection of Germplasm :** Genetic variability from various relatives of the cultivated species are collected to maintain the genetic diversity of a species. The entire collection of the diverse alleles of a gene in a crop is called the germplasm collection.

(ii) **Evaluation of Germplasm and selection of parents :** The germplasm collected is then evaluated for the desirable genes. The selected plants with the desired genes are then used as parents in plants breeding experiments and are multiplied by process of hybridization.

(iii) **Hybridization between selected parents:** The next in plant breeding is to combine the desirable characters present in two different parents to produce hybrids. It is a tedious job as one has to ensure that the pollen grains collected from the male parent reach the stigma of the female parent.

(iv) **Selection of superior hybrids :** The progenies of the hybrids having the desired characteristics are selected through scientific evaluation. The selected progenles are then self-pollinated for several generations to ensure homozygosity.

(v) **Testing, release, and commercialization of new cultivars :** The selected progenies are evaluated for characters such as yield, resistance, performance, etc. by growing them

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179. List any four beneficial effects of GM plants.

Ans : COMP 2015

(a) Increased tolerance against abiotic stresses (cold, drought, salt, heat).

(b) Reduced reliance on chemical pesticides (pest-resistanct crops).

(c) Reduced post-harvest losses.

(d) Increased efficiency of minerals used by plants (this prevents early exhaustion of fertility of soil).

(e) Enhanced nutritional value of food, e.g., vitamin 'A' enriched rice (golden rice).

LONG ANSWER QUESTIONS

180. What is Biotechnology? Describe the application of Biotechnology in Medicines.

Or

What is genetic engineering? How can it be helpful for human welfare?

Ans : OD 2018, DELHI 2010

Biotechnology can be defined as the application of biological organisms system or processes to produce product that are useful for human beings. It is a controlled use of biological agents such as micro-organisms or cellular component for beneficial use.

Some applications of biotechnology in the field of medicine are as follows :

(i) **Gene Therapy :** Gene therapy is a collection of methods that allows correction of genetic defect that has been diagnosed in a child/ embryo. In it, faulty gene is replaced by a normal healthy functional gene.

There are two main methods used for gene therapy:

(a) **Germ line gene therapy :** This is an in vitro method that alter germ line cells. In it, germ cells zygotes are modified by the introduction of functional genes. These altered eggs are then re-implanted into the mother. The changes produced are inheritable.

(b) **Somatic gene therapy :** In it, modified somatic cells with correct copy of genes are introduced into the patient. The changes produced are non-inheritable.

(ii) **Vaccine production :**

The production of vaccines against viruses, such as the herpes and hepatitis virus (second generation vaccines) involves the use of genetic engineering. Genes that code for part of the protein or polysaccharide coat of the herpes simplex virus or the hepatitis-B virus are inserted into vector such as vaccinia virus and then transferred into cultured mammalian cells that generate numerous copies of the recombinant virus, which has the outside coat of a herpes or hepatitis virus.

When the recombinant virus is introduced into a mouse, the immune system of the mouse produced antibodies that develops immunity against herpes or hepatitis virus.

Such vaccines safe because, only a small fraction of the DNA from the disease causing virus is inserted in to the recombinant virus making the vaccine virus less active.

(iii) **Interferons (IFNs) :** These are the antiviral glycoproteins Or lymphokines produce in the infected cells in response to viral infections.

Earlier, or virus infected human cells grown in tissue culture. But now they are produced in large amounts by recombinant DNA technology It was started in 1980 by two American scientists **Gilbert** and **Weisman**.

The interferons are used for the treatment of hepatitis-B, cancer and some viral diseases including AIDS.

(iv) **Monoclonal Antibodies :** These are the Antibodies obtained from a single clone of cells, which recognise only one kind of antigen.

The technique of producing monoclonal antibodies was introduced by **Georges Kohler** and **Cesar Milstein** in 1970 by fusing normal antibody producing cells with from cancerous myeloma cells by a process called as hybridoma technology. One important application of monoclonal antibodies is immune suppression for kidney transplantation.

(v) **Hormones enzymes and chemicals :** Many hormones enzymes and chemicals for the pharmaceuticals have been produced. First biotechnology product is the insulin. Penicillin, streptomycin, kanamycin, tertracyline, growth hormones, proteases, amylase, pectidases, etc. are the products of biotechnology.

(vi) **Diagnosis of infection diseases :** Advancement in biotechnology has made it possible to make an easy, early, quick and correct diagnosis of infections diseases. Diagnostic kits have been developed for AIDS, cancer, foot and mouth diseases, tuberculosis, etc. using the

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(g) Bt tobacco was first cultured to kill hornmworm (Manduca sexta).

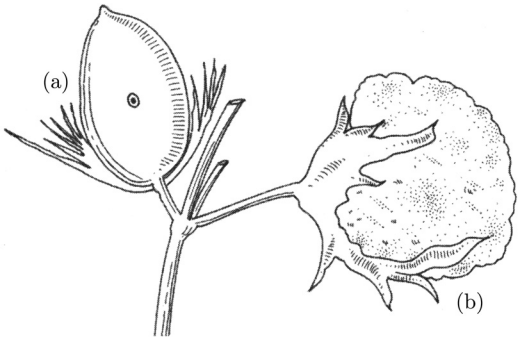

Fig Cotton Boll (a) Destroyed by Bollworms (b) A fully Mature Cotton Boll

194. Diagrammatically represent the experimental steps in cloning and expressing a human gene (say the gene for growth hormone) into a bacterium like E.coli?

Ans : **SQP 2019**

Gene for HGH could also be synthesized and cloned in E.coli, where it is expressed under the control of lac promoter.

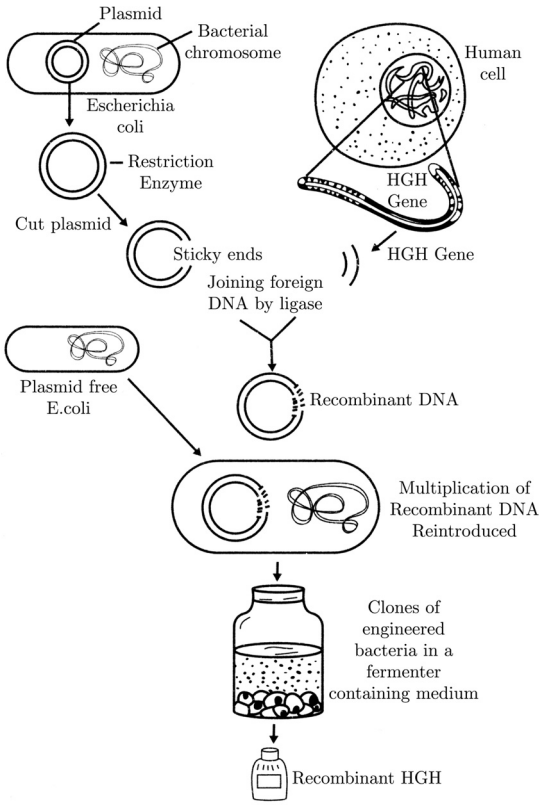

Fig Steps Involved in Gene Transfer in the Production of Human Growth Hormone

This was the first example where a human polypeptide was directly expressed in E.coli in a non-precursor form. In human cells, this protein is synthesized in a precursor form, from a split gene with three introns. The presence of extra regulatory sequence and introns would have hindered the progress, if a synthetic gene was not available.

Production of human insulin and human growth hormone were the first examples demonstrated the importance of gene technology in synthesis of substances of great medical importance.

195. Consult internet and find out how to make orally active protein pharmaceutical. What is the major problem to be encountered?

Ans : **FOREIGN 2016**

Proteinaceous drugs cannot be taken orally because they can be degraded by the proteases enzymes of our alimentary canal. Oral insulin is an example of orally active protein. Its method of manufacturing is based upon 2 phase liquid system. Combine albumin and lecithin in equal proportions in sterile water. Mix thoroughly the components while storing the mixture undisturbed until the composition of this step separates into 2 layers. One above the other. The lower phase being a substantially non-polar coacervate phase, the upper phase being an equilibrium water phase. Continuing the separation process until no increase in the volume of coacervate system can be observed. Centrifuging the composition until inspection reveals a clear demarcation of the two phases. Separating the 2 phases. The desired amount and type of insulin is then added to the coacervate phase and mixed thoroughly. It gets coated by a film that is resistant to degrading enzyme. After this step, the preparation may be dispensed as an oral dosage form of insulin. The various problems which encounters during its manufacturing are:

1. Proteins are difficult to work with.
2. Large molecule proteins can't be administered in oral dosage form.
3. Lack of infrastructure to produce major biopharmaceutical products.
4. Increase in cost of production and quality control.

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in research fields for at least three growing seasons in different parts of the country. After through testing and evaluation, the selected varieties are given to the farmers for growing in fields for a large-scale production.

183. What is tissue culture? What are the different types of tissue culture? Describe briefly.

Ans : **OD 2012**

Plant Tissue Culture refers to the technique of growing plant cells, tissues, organs, seeds or other plant parts in a sterile environment on a nutrient medium.

Branches of tissue culture : Various branches of tissue culture are as follows.

(i) **Callus culture :** Callus culture may be defined as production and maintenance of an un-organized mass of proliferative cell from isolated plant cell, tissue or organ by growing them on artificial nutrient medium in glass vials under controlled aseptic conditions.

(ii) **Organ Culture :** The organ culture refers to the in vitro culture and maintenance of an excised organ primordial or whole or part of an organ in way and function.

(iii) **Suspension culture :** Suspension culture is a type of culture in which single cell or small aggregates of cell multiply while suspended in agitated liquid medium. Suspension cultures are used in induction of somatic embryos and shoots, production of secondary metabolites, in vitro mutagenesis, selection of mutants and genetic transformation studies.

(iv) **Embryo Culture :** Embryo culture may be defined as aseptic isolation of embryo (of different developmental stages) from the bulk of maternal tissue physical condition in glass vials containing nutrient semisolid or liquid medium to grow directly into plantlet.

(v) **Anther culture :** Androgenesis is the in vitro development of haploid plants originating from potent pollen grains through a series of cell division and differentiation.

(vi) **Pollen culture :** Pollen culture is the in vitro technique by which by which the pollen-grains are squeezed from the intact anther and then cultured on nutrient medium where the microspores without producing male gametes.

(vii) **Somatic Embryogenesis :** Somatic embryogenesis is the process of a single a group of cells initiating the development pathway that leads to reproducible regeneration of non-zygotic embryos capable of germinating to form complete plants.

(viii) **Protoplast Culture :** It is the culture of isolated protoplasts which are naked plant cells surrounded by plasma membrane which is potentially capable of cell wall regeneration, cell division, growth and plant regeneration on suitable medium under aseptic condition.

(ix) **Shoot tip and Meristem culture :** The tips of shoots (which contian the shoot apical meristem) can be cultured in vitro producing clumps of shoots from either axillary or adventitious buds. This method can, be used for clonal propagation.

184. Give an account of industrial application of biotechnology.

Ans : **OD 2009**

The various application of biotechnology in industrial field are as follows:

(i) **Fuel Industry :** Biofuel Ethanol is generally produced by fermentation of some sugar (starch, cellulose) rich products with the help of yeast, Saccharomyces cerevisiae or Kluyveromyces fragilis. Now a days E. coli and Klebsiella planticola carrying genes from Z. mobilis have been developed which could utilize glucose and xylose as the substrate to give maximum yield of ethanol.

(ii) **Metabolic Engineering :** In it, metabolic networks are restructured by the recruitment of proteins from different cells which results in a change in pathway distribution and rate. By combining the metabolic capabilities from two organisms entirely new products and intermediates are being synthesised.

(iii) **Improvement in Fermentation Product :** This can be achieved by different ways such as by selection of improved strain, by transgene application into the micro-organism, by using cheaper raw material, by manipulation of medium constituent as well as by simulation of the reactor (adjustment of different cultural conditions like pH, temp., etc.). Products of microbial fermentation include primary metabolites, secondary metabolites, enzymes, proteins, capsular polysaccharides and cellular biomass (single cell protein).

(iv) **Oil Industry :** According to various requirements the fatty acid quality and yield can be improved by using genetic engineering

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technology. For example, the wild type canola (repeseed) contains 60% oleic acid along with some other fatty acids. A genetically engineered canola was constructed with a single gene from the California bay tree that encodes an enzyme involved in the synthesis of lauric acid. These transgenic canola seeds contain 60% lauric acid instead of 60% oleic acid; The new oil resembles the oil found in coconut and palm oil. The production of such genetically engineered oil has already been commercialized.

185. Enlist some of the products of DNA recombinant technology.

Ans : **DELHI 2019**

Given below is the list of some of the important products of DNA recombinant technology.

	Recombinant Product	**Applications**
1.	Human Insulin (Humulin)	Treatment of diabetes type-I
2.	Human Growth Hormone (HGH)	Replacement or augmentation of deficient hormone in short stature persons .
3.	Calcitonin	Treatment of rickets.
4.	Vaccines	For preventing diseases like herpes, hepatitis B, influenza, meningitis, pertussis etc.
5.	Interleukins	Enhancing activity of immune system.
6.	Platelet Growth Factor	Stimulation of wound healing.
7.	Blood Clotting Factors VIII and IX	Replacement of clotting factor missing in patients with haemophilia A or B.
8.	Tissue Plasminogen Activator	Dissolving blood clots after heart attack and stroke.
9.	Chorionic Gonadotropin	Treatment of infertility.
10.	Erythropoietin	Stimulation of erythrocyte formation in anaemic patients during kidney dialysis or treating side effects of drugs in AIDA patients.
11.	Interferon (α,β and γ)	Treatment of viral infections and cancer.

186. Explain the following terms in one or two sentences

(i) intellectual property rights

(ii) humulin and

(iii) bio-fortified foods.

Ans : **SQP 2015**

(i) **Intellectual property rights :** Intellectual property rights (IPRs) are rights to make, use and sell a new product or technology for a period of 20 years to the inventor. These are granted in the form of patents, trademarks and copyrights.

(ii) **Humulin :** Humulin is the commercial name given to human insulin by an American firm Eli Lily. These insulins are manufactured by genetic engineering using fermentation of appropriate medium containing recombinant E.coli clones.

(iii) **Bio-fortified foods :** With the help of genetic engineering techniques, biotechnologists have developed such plants which are rich in nutritional contents. These are potato with increase starch content upto 20-40%, tomato with delayed ripening, golden rice which is rich in vitamin A.

187. Describe in detail the role of biotechnology in diagnosis of diseases.

Ans : **FOREIGN 2011**

Nowadays, biotechnology is contributing a lot to medicines both in the diagnosis of diseases and in the development of pharmaceutical product. Its main purpose is to identify the genes whose mutations, causes genetic diseases. All diseases involve changes in gene expression within the affected cells and within the patient's immune system. By comparing gene expression in healthy and diseased cells, biotechnologists may identify genes which are turned on or off in particular diseases.

(i) **Polymerase chain reaction (PCR) :** It is a technique by which any piece of DNA can be copied many times in short period. If the

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source of DNA is impure it can be amplified by using PCR technique. Amplification makes DNA identification much easier. For example, the sequence of HIV from DNA is known, its amplification by PCR can help to detect HIV, DNA in blood or tissue samples. DNA from single embryonic cells is amplified by PCR for rapid prenatal (before birth) diagnosis of genetic disorders. DNA technology can help to identify individuals with genetic disorders before the appearance of symptoms or carriers of potentially harmful recessive alleles.

(ii) **Pharmaceutical Products :** With the help of genetic engineering, the gene for a desired protein is transferred into bacteria or yeast and a large amount of proteins can be produced in short time or the gene is directly inserted inside the host cells to avoid purifications. Some pharmaceutical products like:

(a) **Hormones :** Mammalian hormones are produced by DNA Technology, e.g., Human growth hormone (HGH), insulin etc.

(b) **Immunomodulations :** These fight with certain diseases where traditional drug therapy does not work.

(c) **Antisense nucleic acids :** These are single stranded DNA or RNA which pairs with mRNA and block translation and inhibit the propagation of diseases like cancer.

(d) **Genetically engineered proteins :** They mimic or block the surface receptors of cell membranes. For example, one such protein mimics the HIV surface receptor protein as a result the HIV virus binds to this protein and fails to enter the white blood cells. Recombinant DNA technology is also helpful in the production of vaccines.

(e) **Interferons :** These are proteins which limit the cell-to-cell spread of viruses inside the host, Interferons can be produced in large amounts by recombinant DNA technology.

(iii) **Gene therapy :** It may help scientists to replace the defective genes with normal genes. This new system of medicine is called gene therapy.

188. Write short notes on (i) Bioethics (ii) Genetically modified food.

Ans :

(i) **Bioethics :** Bioethics are a set of standards that may be used to regulate our activities in relation to biological works. The major bioethical concerns are as follows:

(a) Introduction of transgenes from one species to another violates the integrity of species.

(b) Transfer of human genes to other animals and vice-versa is against ethics.

(c) Making of clone.

(d) May cause risk to biodiversity.

(e) Sufferings to animals used in biotechnology research work will increase.

(ii) **Genetically Modified Food :** The food prepared from the produce of genetically modified crops is called genetically modified food (GM food). It contains proteins produced by transgene. It also contains the enzyme produced by antibiotic resistance gene.

It is an accepted fact now that the biological diversity with different kinds of plants and animals ensures food supply and maintenance of ecological balance in nature. The difference in the type of cultivated plants and domestic animals throughout the world has been determined by difference in natural habitats. It is attributed to their germplasm also. Biological diversity is threatened by encroachment on natural ecosystems by the activities of ever growing human population.

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189. How is the Bt cotton plant created as a GM plants? How is it protected against bollworm infestation?

Ans : **OD 2011**

Genetic modification in cotton (Bt cotton) : It is based on the Ti (Tumour inducing) plasmid which occurs in the soil bacterium, Agrobacterium tumefaciens.

(i) This bacterium infects all broad-leaved agricultural crops such as tomato, soyabean, sunflower and cotton etc. It induces formation of cancerous growth called a crown gall tumour. This transformation of plant cells is due to the effect of Ti plasmid carried by the pathogenic bacterium. Hence, for genetic engineering purposes, Agriobacterium strains are developed in which tumour-forming genes are deleted. These transformed bacteria can still infect plant cells.

(ii) Bt toxin genes are isolated from Bacillus thuringiensis and incorporated into the several crop plants such as cotton. The choice of genes depends upon the crop and targeted pest, as most Bt toxins are insectgroup specific. The toxin is coded by a gene named

cry. These are numerous genes. For example, the proteins encoded by the genes cry IAc and cry IIAb control the cotton bollwroms that of cry IAc controls corn borer.

(iii) The part of Ti plasmid with desired Bt-toxin gene spliced into it, is inserted into the chromosomes of the host plant where it produces copies of itself, by migrating from one chromosomal position to another at random. But it no longer produces tumours.

(iv) Such plant cells then cultured, induced to multiply and differentiate to form plantlets.

(v) Transferred into soil, the plantlets grow into mature plants, carrying the Bt toxin gene, expressed throughout the new plant. Bt toxin gene form some protein crystals. These crystals contain a toxic insecticidal protein. The Bt toxin proteins exist as inactive protoxins but once an insect ingests the inactive toxin it is converted into an active form of toxin due to the alkaline pH of the alimentary canal that solubilizes the crystals. The activated toxin binds to the surface of midgut epithelial cells and create pores which cause cell swelling and lysis and finally cause death of the bollworm insect.

190. Name the nematode that damages the roots of tobacco plants. How is a transgenic tobacco plant made resistant to nematode using biotechnology?

Ans : **COMP 2006**

Pest-resistant plants : Several nematodes, parasitise a wide variety of plants and animals.

(i) A nematode Meloidegyne incognitia infects the roots of tobacco plants and reduces the yield.

(ii) A process RNA interference, prevents this infestation. It is a method of cellular defence which takes place in all eukaryotic organisms. It involves silencing of a specific m-RNA due to the complementary ds-RNa molecule that binds to and prevents translation of m-RNA (silencing),

(iii) The source of this complementary RNA could be from an infection by viruses having RNA genome or mobile genetic elements (transposons) that replicate via an RNA intermediate.

(iv) Using Agrobacterium vectors, nematode specific genes were introduced into host plant.

(v) The introduction of DNA produced both sense and antisense RNA produced both sense and antisense RNA in the host cells.

(vi) These two RNAs being complementary to each other formed a ds-RNA that initiated RNAi and thus silenced the specific m-RNA of the nematode.

(vii) As a result the parasite could not survive in a trasgenic host expressing specific interfering RNA.

(viii) The transgenic plant, therefore, got itself protected from the parasite.

191. Write a critical essay on Applications of Biotechnology.

Ans : **OD 2005**

Applications of Biotechnology are as follows :

1. **Food :** The important foods employing micro-organisms during their preparation are Bread, Idli, Dosa, Acid Porridge, Shoyu, Soy sauce, Miso, Koji Tempeh, Ontjom etc.
2. **Dairy products :** Yogurt (= yoghurt), Crud, Kefir (Russian), Cheese and Butter require specific strains of micro organisms during their preparation or maturation.
3. **Alcoholic beverages :** Beers, Wines, Whisky, etc. are produced through fermentation of different foods by suitable microbial process.
4. **Non-alcoholic beverages :** Curing of coffee beans and Tea leaves is a microbial process.
5. **Sewage treatment :** Different types of bacteria, fungi and algae take part in removal of organic matter in the sewage.
6. **Biogas (Gobar gas) :** Cowdung, farm refuse, garbage etc. are placed in biogas plants where anaerobic conditions allow methane bacteria to produce methane and other fuel gases. The organic remains of the biogas plants are used as manure.
7. **Biofertilizers :** They are mostly nitrogen fixing microorganisms which may live free in the soil or from associations with plants. Special strains of these organisms are now inoculated to soil or seeds.
8. **Organic acid :** A number of organic acids (acetic acid, lactic acid, citric acid, gluconic acid) and amino acids are obtained through biotechnology.
9. **Enzymes :** Enzymes required for industrial and medicinal use are available from microbial processes.
10. **Vitamins:** Some vitamins are still manufactured with the help of microorganisms. Others are synthesised chemically. Food yeast is rich in both proteins and vitamins.

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11. **Antibiotics :** Only a few are synthetic. All others are products of microorganisms.
12. **Vaccines :** They are employed for providing immunity against important diseases. Vaccines contain attenuated or killed pathogens or their antigens.
13. **Monoclonal antibodies :** Antibodies against pathogens can now be obtained in active form from clonal cultures.
14. **Hormones :** Insulin, growth hormone and other hormones are presently synthesised through the use of microbes and genetic engineering.
15. **Tissue culture :** This is an important tool for improvement of agriculture, forestry, introduction of mutations and resistance, synthesis of specific biochemicals etc.
16. **Genetic engineering :** Recombinant DNA technology is applied to several biotechnological processes in obtaining particular biochemicals, improvement of genetic make-up of organism and fighting genetic defects.
17. **Transplants :** Test tube babies and embryo transplants are now being routinely undertaken for production of offspring of desired parents.
18. **Steroids :** Microorganisms are employed for transformation of one types. Steroids and some other products are regularly employed in antifertility formulations.

192. What is gene therapy? Illustrate using the example of adenosine deaminase (ADA)deficiency.

Ans : **SQP 2016**

Gene therapy is a collection of methods that allows correction of a gene defect that has been diagnosed in a child/emgryo.

It is defined as the introduction of a normal functional gene in the cells which contain the defective mutant allele of a concerned gene with the aim of correcting a genetic disorder or hereditary disease.

For example, this technique can be used to correct the genetic disorder called severe combined immuno deficiency (SCID) syndrome. It is produced by the deficiency of adenosine deaminase (ADA). The enzyme is crucial for immune system to function. In some children, ADA deficiency can be cured by Bone marrow transplantation or in others it can be treated by enzyme replacement therapy. However, both of these methods are not completely curative. In this

1. Normal gene, for ADA is amplified by cloning producing several copies of the gene
2. Packed into infective retrovirus, most of viral genes get replaced by ADA gene
3. Isolation of lymphocytes from the patients, artificial growth on a culture medium
4. Introduction of functional ADA normal genes into the lymphocytes and finally (v) The infected lymphocyte cells expressing the ADA gene are injected back into the patients. The normal ADA gene expresses in the patients and ADA deficiency is partially corrected.

Since the life span of lymphocytes varies from few days to months, the patient requires periodic infusion of such genetically engineered lymphocytes. However, if the ADA gene isolated from marrow cells is introduced into cells at early embryonic stages, then it is a permanent cure.

Through the "Human Genome project" most human genes and sequences have been identified, genetic disorder such as eczema, cancer, haemophilia, thalassemia and cystic fibrosis can be cured by insertion of correct genes into these patients.

193. Explain how has Bacillus thuringiensis contributed in developing resistance to cotton bolloworms in cotton plants.

Ans : **DELHI 2009**

(a) Some strains of Bacillus thuringiensis produce proteins that kill some insects like lepidoperans (tobacco budworm, armyworm), coleopterans (beetles) and dipterans (flies, mosquitoes).

(b) B.thuringiensis forms protein crystals which contain a toxic insecticidal protein.

(c) Bt toxins are initially inactive protoxins but after ingestion by the insect their inactive toxin becomes active due to the alkaline pH of the gut, which solublises the crystals.

(d) The activated toxin binds to the surface of midgut epithelial cells thus creating pores which causes cell swelling and lysis, further, leading to death of the insects.

(e) Specific Bt toxin genes obtained form Bacillus thuringiensis are used in several crop plants like cotton.

(f) The toxin is coded by a gene called cry which is of various types. For example, proteins encoded by the genes cryIAc and cryIIAb control the cotton bollworms and that of cryIAb coantrol corn borer.

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(v) These two RNas are complementary to each other and form a double-started RNA (dsRNA) that initiates RNAi and hence silence the specific mRNA of the nematode.

(vi) The parasite cannot survive in the transgenic host, so protects the plants from pests.

174. What are transgenic bacteria? Illustrate using any one example.

Ans : **OD 2019**

Transgenic bacteria are those bacteria in which the genome is modified by the artificial introduction of a foreign gene or series of genes. For example, two DNA sequences coding for A and B chain of human insulin hormone were introduced into the plasmid of a bacterium E.coli. This genetically modified bacteria-transgenic bacteria started producing insulin hormone.

175. What are Cry proteins? Name an organism that produce it. How has man exploited this protein to his benefit?

Ans : **DELHI 2006**

Cry proteins are encoded by genes termed as cry genes present in Bacillus thuringiensis. They have molecular wt.ranging form 70-136 KDa. These proteins are toxic and can kill the number of different types of animals especially insects and can be used as insecticides. Specific Bt toxin genes were isolated and incorporated into several crops such as cotton. As the most Bt toxins are insect group specific, the choice of genes to be incorporated depends upon the crop and target pest. There are number of cry genes such as cry IAc and Cry IAb. The proteins coded by the two above stated genes, control the attack of cotton bollworms, that of Cry IAb control the pest corn borer.

176. Does our blood have protease and nucleases?

Ans : **SQP 2007**

Yes, our blood have both proteases and nucleases. Monocytes of WBCs enlarge into macrophages. These cells are phagocytic in nature. Macrophages are fixed and wandering. They catch hold of the microbes and dead cells that are carried along the blood and lymph. Whenever, a bacterium, enters the macrophage or neutrophils, it forms a phagosome. The phagosome fuses with the lysosome to form phagolysosome for the digestion of bacterium. The lysosome contain various types of hydrolytic enzymes-proteass, nucleases, lipases and glycosidases etc.

177. Explain the role of transgenic animals in (i) Vaccine safety and (ii) Biological products with the help of an example each.

Ans : **FOREIGN 2010**

(i) **Vaccine safety :** Transgenic mice/monkeys are being developed for use in testing the safety of vaccines (e.g., polio vaccine)

(ii) **Biological products :** Animals producing useful biological compounds can be created by introducing a portion of DNA that codes for that product from other organisms, e.g., α-I-antitrypsin, a human protein used to treat emphysema. The first transgenic cow, Rosie, produced the human-protein enriched milk (2.4 g/litre); it also contained human alphalactoalbumin, a more nutritionally balanced product for human babies.

178. Compare and contrast the advantages and disadvantages of production of genetically modified crops.

Ans : **OD 2016**

Advantages :

1. GM crops have improved agronomic and other feature such as resistance to biotic and abiotic stresses.
2. They increase the productivity of crop generally by showing resistance against plant pathogens and some herbicides.
3. Transgenic plants have been produced that contain a gene encoding an antigenic protein from a pathogen. When mice were fed on such plant produce they become immunised against the pathogen. Therefore, use of transgenic plants as vaccines for immunisation against pathogens is fast emerging as an important objective.
4. Transgenic crops grow well in saline soil and show salt resistance.
5. Transgenic crops with excess of vitamins and minerals have been developed. They have enhanced nutritional quality and yield.

Disadvantages :

1. Sometimes expression of transgenes is suppressed in transgenic plants a phenomenon called gene silencing.
2. Transgenes in commercial crops can endanger native species e.g., Transgene in Bt-cotton producing toxin proteins expressed in pollen might endanger pollinators like honey bees.
3. Transgene crops cause problems in human health by supplying allergens and transfer of antibiotic resistance markers.
4. These crops cause damage to the natural environment.

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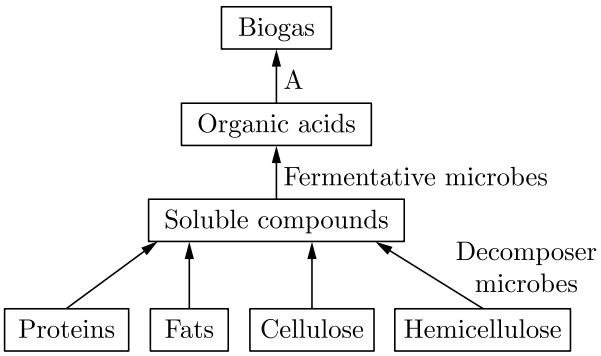
CASE BASED QUESTIONS

196. The flow chart given below shows the different components of biogas plant.



(i) With reference to the given flow chart, explain why there is a need of A?

(ii) What would happen if A is not added in the procedure?

(iii) Where does A can be found apart from the biogas production?

(iv) What is the significance of biogas produced by A?

Ans :

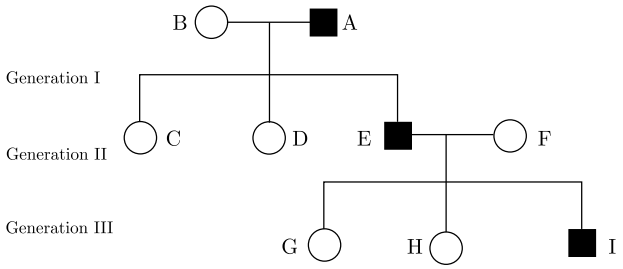
(i) There is a need of A i.e., methanogenic bacteria (Methanobacterium) to produce the biogas that grows anaerobically on cellulosic bacteria.

(ii) If methanogenic bacteria (A) is not added in the procedure, methane will not be formed.

(iii) Organism A i.e., methanogens can also be found in the anaerobic sludge during sewage treatment and in the rumen of the cattle.

(iv) Biogas is a mixture of gases ($CH_4 + CO_2 + H_2$) produced by the microbial activity (methanogens, A). It is used as fuel for heating, cooking and lighting. It is considered eco-friendly and pollution free source of energy.

197. The following pedigree chart shows the inheritance of a genetic disorder up to three generations of a family. Observe the chart and answer the questions that follow.



(i) Is the disease sex-linked or autosomal as per the chart ? Give reasons in support of your answer.

(ii) Is it a recessive or a dominant disorder ?

(iii) Write the genotypes of the individuals 'C','D' and 'H'.

(iv) (a) If the female 'D' marries a normal man, what will be the probability of their daughter being a sufferer of this disease ?

(b) disease, what will be the probability of their daughter being a sufferer of this disease ?

Ans : **OD 2023**

(i) (a) Sex linked disorder

(b) More males are affected in the family as males have only one X chromosome which if affected expresses

(ii) Recessive disorder

(iii) C -XX^c; D- XX^c; H- XX^c

'c' is affected allele, accept other symbols used for the same

(If any two genotypes are correct then award 1 mark)

(iv) (a) Probability 0%

(b) Probability-50%

198. Some strains of Bacillus thuringiensis produce proteins that kill certain insects such as lepidopterans (tobacco budworm, armyworm), coleopterans (beetles) and dipterans (flies, mosquitoes). B. thuringiensis forms protein crystals during a particular phase of their growth. These crystals contain a toxic insecticidal protein. Why does this toxin not kill the Bacillus. Actually, the Bt toxin protein exist as inactive protoxins but once an insect ingest the inactive toxin, it is converted into an active form of toxin due to the alkaline pH of the gut which solubilise the crystals. The activated toxin binds to the surface of midgut epithelial cells and creates pores that cause cell swelling and lysis and eventually cause death of the insect. Specific Bt toxin genes were isolated from Bacillus thuringiensis and incorporated into the several crop plants such as cotton. The choice of genes depends upon the crop and the targeted pest, as most Bt toxins are insect-group specific. The toxin is coded by a gene named cry. There are a number of them, for example, the proteins encoded by the genes cryIAc and cryIIAb control the cotton bollworms that of cryIAb control corn borer.

(i) What is role of cry II Ab and cry I Ab?

(ii) Specific Bt toxin gene was isolated from which organism?

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zero; r shows intrinsic rate of natural increase and e expresses base of natural logarithms (2.71828)].

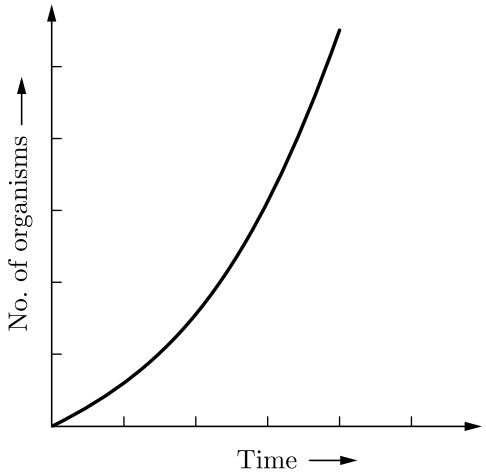

Fig The exponential growth curve

15. GROWTH OF POPULATION

When a species grows exponentially under unlimited food and space (resource conditions). This may reach enormous population densities in a very short time. Charle Darwin explained how even a slow-growing animal e.g., elephant could each huge numbers in absence of environmental checks. A population may be changed exponentially for indefinite time.

16. LOGISTIC GROWTH

It is for the population of any species found in nature and growing in unlimited resources food, space to allow the exponential growth. In a given habitat, the nature has provided resources for supporting a maximum possible number and beyond that further growth is impossible. This is known as nature's carrying capacity for a species living in a habitat. It is represented by K.

17. CARRYING CAPACITY

It shows "the maximum number of individuals of a population that may be supported in a given habitat". Any population that grows in a habitat with limited resources (e.g., limited space) represents in the beginning a lag phase. This is followed by phases of the acceleration as well as the deceleration and finally an asymptote, when population density or N reaches carrying capacity. If we plot of N in relation to time t its results in a sigmoid growth curve. This kind of population growth is known as the Verhurst-Pearl Logistic Growth.

The Equation for it is :

$$\frac{dN}{dt} \quad rN\frac{(K-N)}{K}$$

[Where, N is population density at time t; r is intrinsic rate of natural increase; K is carrying capacity.]

It was explained by Verhurst (1838) and Reed (1920) for human population.

As the resources for growth of an animal populations are finite; but become limiting later logistic growth model is more realistic for them.

Therefore

The Rate of population for with per unit time (t)

= Innate capacity for increase (rm)

$\times$ the size of population $\times$ unutilized population growth.

18. LIFE HISTORY VARIATION

The populations exhibit high r-value/Darwinian fitness in their habitats. So, they evolve some **reproductive fitness. Examples :**

1. Pacific Salmon Fish and Bamboo. Breed once in their life time.
2. Pelagic Fishes and Oysters. They produce small sized progeny.
3. Birds and Mammals. They produce big sized progeny.

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(ii) State the role of C peptide in human insulin ?

(iii) Mention the chemical change that pro insulin undergo to be able to act as mature insulin.

Ans : **COMP 2011**

(i) Two short peptides chain of insulin are linked together by disulphide bridges.

(ii) C peptide makes the insulin active.

(iii) An extra stretch called C peptide is removed from pro insulin during maturation.

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CHAPTER 11

ORGANISM AND POPULATION

SUMMARY

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1. ECOLOGY

It refers "to the study of reciprocal reactions of organisms to their surrounding." The environment is "the sum total of external factors affecting the organisms where they live in."

2. ORGANISM AND ITS ENVIRONMENT

At the organismic level, the ecology is physiological ecology because it explains the adaptations of organisms in terms of reproduction and survival of the fittest.

3. BIOSPHERE

The biosphere involves all ecosystems on the earth. The environment affects on climate, biota and vegetation. The abiotic (physicochemical) components and biotic form a habitat at all.

4. ADAPTATIONS

The organisms cope with their environment in extreme conditions by alternative available to them.

Ecological Adaptations : Warming has categorized the plants on the soil and water availability Hydrophytes grow in water on near water. Xerophytes are adapted to live well in dry conditions and scarcity of water. Mesophytes thrive well in moderate environment of water, i.e., neither dry nor much wet.

CAM plants remain their stomata **closed** during day time. Mammals in colder parts have mostly **shorter ears** as well as limbs to minimize heat loss. It is called **Allen's Rule**. The seals posses **blubber** below their skin and it acts as an **insulator**.

4.1 Endotherms and Exotherms

Endotherms have internal body mechanisms to keep body temperature constant. They may keep the body temperature within tolerable limits also. This is called homeostasis. Exotherms have devices for it.

4.2 Archabacteria

They thrive very well in hot springs and deep hydrothermal vents.

5. POPULATIONS

Isolated single individual organism of any species may live but some live in groups in a geographical area, breed and use common resources. A geographical localised group of individuals of the same kind at a particular time represents a population in ecology e.g., all individuals of common grass called Cynodeon.

Metapopulation is "set of populations connected by dispersing individuals." Local population occupy small habitats.

Krebs (1976) defines population as "a group of organisms of the same species occupying a particular space in the give time."

6. SIZE OF POPULATION

It may be low or may be in millions. It is called populations density; it is represented by N.

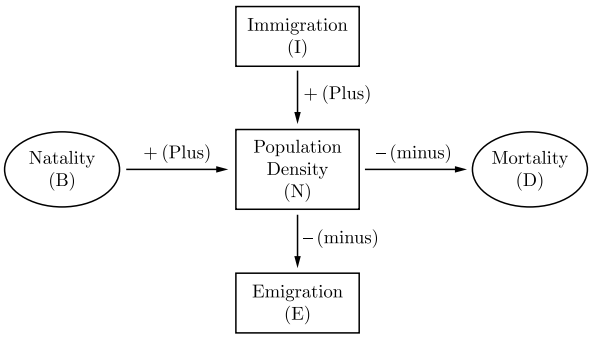

Fig Population density

7. POPULATION GROWTH

This changes with time. It is defined "as the total number of increase in the organisms occupying some particular area."

8. POPULATION DENSITY

The population is defined as "a group of individuals of the same species inhabiting the same area". The members of the population are capable of interbreeding among themselves e.g., millions are Chlamydomonas in a pond.

A population is characterised by parameters such as density, natality, mortality, age distribution, biotic potential, growth form, etc.

It is determined by various factors in a region. It is expressed as :

$$D = \frac{n/a}{t}$$

(D = density; t = time; n = number of individual; a = occupied)

9. ATTRIBUTES OF POPULATION

1. **Natality :** It refers "to the number of births during a given period in the population which are added to initial density."
2. **Mortality :** It refers "to the number of deaths in a population during a given period/time". It is just reverse to natality. It may be of 2 kinds : (i) potential and realized mortality (actual death rate). It is expressed per thousand.
3. **Immigration :** It is "number of individuals of same species that have come into habitat from elsewhere during the time period under consideration." This leads to an increase in size of the give population.
4. **Emigration :** It is "number of individuals of a populations which left habitat and gene elsewhere during time period under consideration." This leads to decrease in the size of a given population. Therefore, if N = population density at time (t). The density at time $t+1$ will be shown by the expression $\rightarrow N_{t+1} = N_t + (B + I - D - E)$ where B = natality rate;
   I = immigration; D = mortality rate and E = Emigration.

10. THE GROWTH MODELS

There are two specific patterns of increase in growth form of a population :

(i) J-shaped growth form and

(ii) S-shaped growth form.

Some conditions affect the population growth rate.

The size of population is represented by density. The maximum size of the population that may be supported in a given habitat is known as its carrying capacity.

Biotic potential is represented by the symbol 'r'. It is the "inherent capacity of an organisms to increase in its number." Population of different species inhabiting in a habitat constitute the 'biotic community'.

11. THE EXPONENTIAL GROWTH

The food and space are two factors and their availability is necessary for unimpeded growth of population. Ideally, when food and space in a habitat are unlimited, each species has capability to realize fullinnate potential for growth. It was seen by Charles Darwin when he put forward the theory of natural selection (called Darwinism). The population grows rapidly.

12. THE EXPONENTION/GEOMETRIC GROWTH

The population growth may be exponential or geometric in fashion. Suppose in a population of size say N, birth rates (not total number but per capita births) are exhibited by b, the death rates (the per capita death rates) by d; then increase or decrease in population size N during a unit time period t; (dN/dt) would be as :

Hence, $dN/dt = (b - d) \times N$

Suppose $(b - d) = r$

Then, $dN/dt = rN$

[where r = Intrinsic Rate of Natural Increase]

13. INTRINSIC RATE OF GROWTH

The rate of growth of diatoms in Michigan Lake of USA undergoes exponential increase when conditions of resources are suitable : Then r in the above equation is known as Intrinsic Rate of Natural Increase. The essential parameter to asses the impacts of a biotic/abiotic factor on the population growth. Take the example of magnitude of r values, for Norway Rat r=0.015 and flour beetle $r = 0.12$. The r value for human population in India in 1981 was 0.0205.

14. EXPONENTIAL POPULATION GROWTH CURVE

The expression $dN/dt = rN$ explain exponential or geometric growth pattern of the population. It results in the J-shaped curve if we plot N in relation to time (t). The integral form of exponential growth equation as represented as :

$$N_t = N_0 e^{rt}$$

[where N_t represent Population density after time (t); N_0 represents population density at time

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26. How much of the world's land area, India has?
(a) 1 percent (c) 2.4 percent
(b) 40 percent (d) 80 percent

Ans : COMP 2020
Of the entire world's land area, India has 2.4 percent with a total area of 3,287,263 square kilometers as seventh-largest country in the world.
Thus (c) is correct option.

27. Considering May's global estimates, how many of the total species have been recorded?
(a) 1 percent (c) 10 percent
(b) 22 percent (d) 50 percent

Ans : OD 2013
Robert McCredie May is a theoretical ecologist and promoter of science. He estimated that there are almost 7 million species globally. Considering May's global estimates, only 22 percent of the total species have been recorded.
Thus (b) is correct option.

28. Ecotone is:
(a) a polluted area.
(b) the bottom of a lake.
(c) a zone of transition between two communities.
(d) a zone of developing community.

Ans : DELHI 2011
The adjacent of two communities is represented by population of both the communities, and this transition zone between two communities is referred as ecotone.
Rest of the options do not define ecotone (zone of transition).
Thus (c) is correct option.

29. According to Allen's rule, the mammals from colder climates have:
(a) shorter ears and longer limbs.
(b) longer ears and shorter limbs.
(c) longer ears and longer limbs.
(d) shorter ears and shorter limbs.

Ans : SQP 2009
According to Allen's rule, the mammals (endothermal animals) from colder climates or areas show shorter extremities like ears and limbs as compared to the mammals of warm region. The shorter extremise of mammals in colder region help to minimise heat loss and maintain homeostatis. Rest of the other options do not stand true for Allen's rule.
Thus (d) is correct option.

30. What parameters are used for tiger census in our country's national parks and sanctuaries?
(a) Pug marks only
(b) Pug marks and faecal pellets
(c) Faecal pellets only
(d) Actual head counts

Ans : FOREIGN 2006
The parameters used for tiger census in our country's national parks and sanctuaries are foot prints (pug marks) and faecal pellets of conserved animals.
Thus (b) is correct option.

So, the number of people present in 2015 is predicted as 17 millions.
Thus (b) is correct option.

31. What is the growth pattern demonstrated by population at time = 1 of population size of a species over time is shown in the graph (Consider the graph of question 7).
(a) Exponential (c) Gradual
(b) Oscillating (d) Continual

Ans : COMP 2019
The population in above graph increase exponentially at time =1 as this type of graph is shown when resources available to population are unlimited.
Represented by, $\frac{dN}{dt} = rN$
Thus (a) is correct option.

32. Lichens are the associations of
(a) bacteria and fungus
(b) algae and bacterium
(c) fungus and algae
(d) fungus and virus

Ans : OD 2005
Lichens represent a positive (beneficial) interaction between two different species, one fungus and another algae.
Rest of the species combination or associations are not true for lichens.
Thus (c) is correct option.

33. Which one of the following organisms reproduces sexually only once in its life time?
(a) Banana plant (c) Tomato
(b) Mango (d) Eucalyptus

Ans : DELHI 2009
Monocarpic plants are those plants which flower once in their life e.g. all annuals monocarpic plant.
Rest of the options are incorrect.
Thus (a) is correct option.

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OBJECTIVE QUESTIONS

1. The physiological capacity of a species to produce their progeny in absence of predators, diseases and other inhibiting factors is called:
(a) carrying capacity
(b) biotic potential
(c) environmental resistance
(d) population explosion

Ans : OD 2024, COMP 2005
The ability of a population of a particular species to propagate under ideal environmental conditions such as sufficient food supply, no diseases, and no predators, is called biotic potential.
Thus (b) is correct option.

2. Zone of atmosphere near the Earth surface is:
(a) Stratosphere (c) Troposphere
(b) Mesosphere (d) Thermosphere

Ans : OD 2010
The troposphere is the lowest layer of our atmosphere. Starting at ground level, it extends upward to about 10 km (6.2 miles or about 33,000 feet) above sea level. After troposphere, stratosphere (up to 50 km), mesosphere (up to 85 km) and thermosphere (between 500 km – 1000 km) are found.
Thus (c) is correct option.

3. Photosynthetically active radiation (PAR) represent the following range of wavelength:
(a) 450-950 nm (c) 400-700 nm
(b) 340-450 nm (d) 500-600 nm

Ans : DELHI 2015
Photosynthetically active radiation, often abbreviated PAR, designates the spectral range (wave band) of solar radiation from 400 to 700 nanometers.
Thus (c) is correct option.

4. Niche overlap indicates:
(a) mutualism between two species.
(b) active cooperation between two species.
(c) two different parasites on the same host.
(d) sharing of one or more resources between the two species.

Ans : SQP 2019
Organisms or populations in the competition have a niche overlap of a limited resource for which they compete. Both owl and cat feed on shrews and mice it means two or more species sharing of one or more resources.
Thus (d) is correct option.

5. Who is referred as Father of Ecology in India?
(a) Ramdeo Misra
(b) Raja Ram Mohan Roy
(c) Verghese Kurien
(d) MS Swaminathan

Ans : FOREIGN 2018
The Father of Ecology in India is Ramdeo Misra. Raja Ram Mohan Roy was a freedom fighter. Verghese Kurien is the Father of the White Revolution of India while MS Swaminathan is the Father of Green Revolution of India.
Thus (a) is correct option.

6. What is a group of individuals belonging to the same species within an ecosystem called?
(a) Species (c) Biomes
(b) Population (d) Manipulation

Ans : COMP 2014
A group of individuals belonging to the same species within an ecosystem is called population while biomass is plant based renewable organic material and manipulation is a skill full handling work.
Thus (b) is correct option.

7. What is the place where a particular organism lives called?
(a) Factors
(c) Habitat
(b) Niche
(d) Environment

Ans : OD 2011
The place where a particular organism lives is called a habitat. It depends on both biological and physical factors present within it while niche is the unique place of species in an ecosystem and environment is our surroundings.
Thus (c) is correct option.

8. Biosphere is:
(a) a component in the ecosystem.
(b) composed of the plants present in the soil.
(c) life in outer space.
(d) composed of all living organisms present on Earth which interact with the physical environment.

Ans : DELHI 2008
Biosphere is composed of all living organisms present on Earth which interact with their physical environment. In other words a biosphere or ecosphere term is collectively used for all the ecosystems of world.
Ecosphere or biosphere can not be defined by

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(iii) Name the gene that encodes for Bt protein specific to cotton bollworm?

(iv) Consider the following statements (A-D) about organic farming

(A) utilizes genetically modified crops like Bt cotton

(B) uses only naturally produced inputs like compost

(C) does not use pesticides and urea

(D) produces vegetables rich in vitamins and minerals.

Which of the above statements are correct?

(a) B, C and D

(b) C and D only

(c) B and C only

(d) A and B only

Ans :

(i) Cry II Ab and Cry IAb produce toxins that control cotton bollworms and corn borer respectively.

(ii) Specific Bt toxin gene were isolated from Bacillus thuringiensis

(iii) The gene that encodes for Bt protein specific to cotton bollworm is cry II Ab.

(iv) (c)

199. Gene therapy is a collection of methods which allows the corrections of defect that has been diagnosed in a child or embryo. The defective mutant alleles of the genes are replaced by the normal gene insertion to take over the functions of and compensate for the A non-functional gene.

(i) How does ADA deficiency is caused ?

(ii) In which year first clinical gene therapy was attempted and on whom.

(iii) Which other diseases can be treated by gene therapy ?

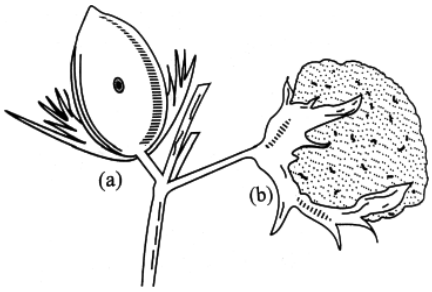
Ans : **DELHI 2016**

(i) A deficiency is caused clue to the deletion of the gene for adenosine deaminase ?

(ii) The first clinical gene I 'wilily was attempted in 1990 on a 4 year old girl with adenosine deaminase (ADA) deficiency by M Blease and WF andresco of National institute of health.

(iii) The other disease that can be treated with gene therapy are haeonphilia, cystic fibrosis, Parkinson's disease.

200. Given below is the figure of two types of cotton bolls; one destroyed by bollworms and the other is fully matured one.



Answer the following questions on the basis of above figure :

(i) What is Bt cotton ?

(ii) Bt toxins are released as inactive crystals in the bacterial body. What happens to it in the cotton bollworm body that it kills the bollworm ?

(iii) List the type of cry genes that provide resistance to corn plants and cotton plants respectively aganist lepidopterans.

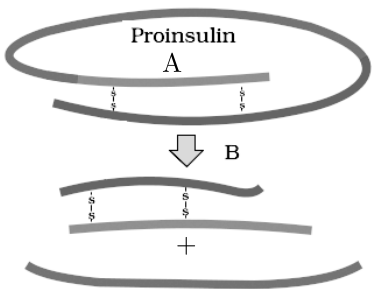
Ans : **SQP 2011**

(i) Bt cotton is a genetically modified pest resistant plant cotton variety, which produces an insecticide to fight against bollworm.

(ii) Bt toxin protein exist as inactive protoxins but once an ingect the inactive toxin, it is converted into an active form of toxin due to the alkaline pH of the gut which solubilise the crystals. The activated toxin binds to the surface of midgut epithelial cells and create pores that cause cell swelling and lysis and eventually cause death of the insect.

(iii) Bt toxin is coded by a gene crylAc named cry. There are a number of them, for example, the proteins encoded by the genes crylAc and cryllAb control the cotton bollworms, that of crylAb controls corn borer.

201. Given below the diagram of maturation of a proinsulin into insulin.



(i) How are the two short peptides chains of insulin linked together ?

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16. Annual migration does not occur in case of:
(a) Arctic tern (c) Siberian crane
(b) Salmon (d) Salamander

Ans : COMP 2016
Migration is common in mammals (e.g. porpoises), fishes (e.g. eels and salmon) and some insects but is most marked in birds. The arctic tern migrates annually from Arctic to the Antarctic region. Salmon usually migrate from marine to fresh water to spawn. The Siberian crane, breeds in arctic Russia and western Siberia. But salamander is an amphibian with slender body, short legs and long tail. So they spend most of their time underground.
Thus (d) is correct option.

17. Animals undergo inactive stage during winter is known as:
(a) aestivation (c) adaptation
(b) hibernation (d) acclimatisation

Ans : OD 2011
Hibernation is the inactive stage or dormancy during winter. Aestivation in Zoology is the dormancy during summer or dry weather. In botany, it is the arrangement of parts in flower bud. Adaptation is the sum total of environmental condition achieved by the organisms in a habitat. Acclimatization is gradual physiological adaptation in response to environmental changes.
Thus (b) is correct option.

18. By studying what processes can we tell the complexity of organisms?
(a) Physical organization
(b) Biological organization
(c) Chemical organization
(d) Physiological organization

Ans : DELHI 2007
As evolution proceeds, organisms become more and more complex. The complexity of organisms can be given by studying various processes of biological organization.
Thus (b) is correct option.

19. What is the first level of organization?
(a) Organ (b) Cell
(c) Organism (d) Macromolecules

Ans : FOREIGN 2016
Macromolecules such as carbohydrates, lipid and proteins are the first level of the organization of any organism. After that cell tissues, organ and organisms are considered.
Thus (d) is correct option.

20. What is the level of the organization after the macromolecules?
(a) Polymer (c) Cell
(b) Tissue (d) Organ

Ans : COMP 2019
The level of the organization after macromolecule is a cell. Many macromolecules of different types come together and give rise to a living entity called cell.
Thus (c) is correct option.

21. What is the level of the organization after the cell?
(a) Macromolecules (c) Tissue
(b) Organ (d) Organism

Ans : OD 2005
The level of the organization after a cell is a tissue. Various cells come together and form a tissue.
Thus (c) is correct option.

22. What is the level of the organization after the organs?
(a) Community (c) Tissues
(b) Cell (d) Organism

Ans : SQP 2015
The level of the organization after an organ is an organism. It means that various organs come together to make an organism.
Thus (d) is correct option.

23. How many species of beetles are present on the Earth?
(a) 3,00,000 (c) 3,000
(b) 30,000 (d) 300

Ans : DELHI 2013
Beetles are a group of winged insects and eat almost everything. They are prominent decomposers, and there are approximately 3,00,000 species of beetles on the Earth.
Thus (a) is correct option.

24. How many species of fishes are present on Earth?
(a) 28,00,000 (c) 280
(b) 28,000 (d) 28

Ans : SQP 2011
There are approximately 28,000 species of fishes on Earth.
Thus (b) is correct option.

25. How many varieties of mango does India have?
(a) 2 (c) 1,000
(b) 10 (d) 20

Ans : FOREIGN 2019
India consists of approximately more than 1,000 varieties of mango.
Thus (c) is correct option.

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other three options, as they represent only a part of ecosystem.
Thus (d) is correct option.

9. Ecological niche is:
(a) the surface area of the ocean.
(b) the surface area of forests.
(c) the physical position and functional role of a species within the community.
(d) formed of all plants and animals living at the bottom of a lake.

Ans : SQP 2007
Ecological niche is determined by factors such as by its range of tolerance i.e., the physical position and functional role of a species within the community. etc while rest of the options are incorrect.
Thus (c) is correct option.

10. Salt concentration (salinity) of the sea measured in parts per thousand is:
(a) 10-15 (c) 0-5
(b) 30-70 (d) 30-35

Ans : FOREIGN 2011
The salt concentration (salinity) of sea is measured in parts per thousand is 30-35.
Thus (d) is correct option.

11. Formation of tropical forests needs mean annual temperature and mean annual precipitation as:
(a) 18-25°C and 150-400 cm
(b) 5-15°C and 50-100 cm
(c) 30-50°C and 100-150 cm
(d) 5-15°C and 100-200 cm

Ans : COMP 2006
Formation of tropical forest needs annual temperature 18-25°C and annual rainfall (precipitation) above 140 cm, usually between 150-400 cm and reach upto 1000 cm/year. Because tropical forest (tropical rain or evergreen forest mainly occurs in equatorial or subequatorial region like Amazon, Central America and Orinco and Congo river basins of South America and Africa respectively.
Thus (a) is correct option.

12. Which of the following forest plants controls the light conditions at the ground?
(a) Lianas and climbers (b) Shrubs
(c) Tall trees (d) Herbs

Ans : OD 2005
In forest, intensity, duration and quality of light at ground is controlled by tall trees, which have higher productivity than shrubs and herbs growing underneath. Lianas and climbers are woody vines which make commensalism association with tall trees. Herbs and shrubs occupy lower strata of forest.
Thus (c) is correct option.

13. Lichens are well known combination of an algae and fungus where fungus is:
(a) an epiphytic relationship between algae.
(b) a parasitic relationship with the algae.
(c) a symbiotic relationship with the algae.
(d) a saprophytic relationship with algae.

Ans : SQP 2015
Lichens are a well-known combination of an algae and a fungus where the fungus has a symbiotic relationship with the algae. The fungus depends on the algae for food, as fungi cannot perform photosynthesis. In return, they provide shelter to the algae.
Thus (c) is correct option.

14. What will happen to a well growing herbaceous plant in the forest if it is transplanted outside the forest in a park?
(a) It will grow normally.
(b) It will grow well because it is planted in the same locality.
(c) It may not survive because of change in its micro climate.
(d) It grows very well because the plant gets more sunlight.

Ans : DELHI 2008
A well growing herbaceous plant in forest receives less intensity, duration and quality of light, but when it is transplanted in a park outside the forest, it will face microclimate charge and may not survive due to uninterrupted receiving of light. Rest of the other options are incorrect to depict the fate of plant.
Thus (c) is correct option.

15. Pneumatophores are present or common in:
(a) xerophytes (c) mesophytes
(b) hydrophytes (d) halophytes

Ans : FOREIGN 2013
Pneumatophore roots are specialized aerial roots in halophytes which help the plants to breathe air in waterlogged soil. Halophytic plants possess the negatively geotropic vertical roots.
Thus (d) is correct option.

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34. What is the interaction between species in which the fitness of one overpowers the presence and fitness of another called?

(a) Competition (c) Parasitism

(b) Mutualism (d) Commensalism

Ans : SQP 2010

In competition interaction, the fitness of one organism overpowers the presence and fitness of another. In these organisms of same or different species, living in the same or different community fights for the same resources.

Thus (a) is correct option.

35. Choose the right combination among the following:

	Interaction	Species A	Species B
A.	Commensalism	–	–
B.	Parasitism	+	–
C.	Mutualism	+	+
D.	Competition	0	–

(a) A, B (b) C, D

(c) A, D (d) C, B

Ans : OD 2008

(a) In commensalism, one is benefited but other has no effect. It is denoted by (+, 0)

(b) In parasitism, one is benefited but other is harmful. It is denoted by (+, –)

(c) In mutualism, both are benefited. It is denoted by (+, +)

(d) Competition is harmful to both the organisms. It is denoted by (–, –).

Thus (d) is correct option.

36. What happens to two species in mutualism?

(a) Only one is benefited

(b) Both live differently

(c) Both are benefited

(d) Only one is harmed

Ans : DELHI 2015

Mutualism is a biological interaction between organisms of different species in which each individual receives a benefit.

Thus (c) is correct option.

37. Autecology is the:

(a) relation of a population to its environment.

(b) relation of an individual to its environment.

(c) relation of a community to its environment.

(d) relation of a biome to its environment.

Ans : FOREIGN 2009

Autecology is the study of relationship of an individual to it's environment. The relation of a population or community to its environment is called synecology. While biome is a collection of ecosystems having similar climates.

Thus (b) is correct option.

38. Which of the following is a partial root parasite?

(a) Sandal wood (c) Orobanche

(b) Mistletoe (d) Ganoderma

Ans : FOREIGN 2020

Sandal wood (Santalum album) is partial root parasite. Mistletoe (Viscum) is considered as hemiparasite and Ganoderma are parasite basidiocarpi.c mushrooms.

Thus (a) is correct option.

39. Geometric representation of age structure is a characteristic of:

(a) landscape (b) ecosystem

(c) biotic community (d) population

Ans : COMP 2006

Geometric representation of age structure is a characteristic of population. In most-populations, individuals are of different ages. The proportion of individual in each age group is called age structure of that population.

Thus (d) is correct option.

40. Exponential population growth is:

(a) $dN/dt = rN$ (c) $dN/rN = dt$

(b) $dt/dN = rN$ (d) $rN/dN = dt$

Ans :

The formula for exponential population growth is $dN/dt = rN$. In this equation, d is the rate of change, N is the number of existing individuals, r is the intrinsic growth rate, t is time, and dN/dt is the rate of change in population size.

Thus (a) is correct option.

41. Study of human population growth is:

(a) Anthropology (c) Demography

(b) Geography (d) Biology

Ans : SQP 2019

Anthropology is study of human behaviour. Demography includes mortality, natality, fertility rate. So it includes the study of human population growth.

Geography is study of relationships of humans with the surrounding environment. The word biology is defined as the science of life and living organisms.

Thus (c) is correct option.

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42. When the number of individuals added to the population exceeds the number of individuals lost, the population experiences:
(a) zero population growth.
(b) exponential population growth.
(c) decrease in biotic potential.
(d) decrease in carrying capacity.

Ans : COMP 2019
In a population, when the birth rate increases then death rate, population tends to expand. So, the number of new members that can be added in a population increases. This causes exponential growth of population.
Thus (b) is correct option.

43. Population density for a particular area can be calculated by:
(a) $D = \frac{N}{S}$ (c) $D = S \times N$
(b) $S = N \times D$ (d) $N = \frac{S}{D}$

Ans : SQP 2006
The formula for finding the population density is D = N/S or population density = a number of organisms/area.
Thus (a) is correct option.

44. Who stated that human population grows geometrically?
(a) Darwin (c) De vries
(b) Lamark (d) Malthus

Ans : FOREIGN 2009
Malthus was a clergyman and economist, who wrote an essay "Principle of population as it affects future improvement of society". In this essay, Malthus stated that populations can increase geometrically, while food supply can increase arithmetically only.
Thus (d) is correct option.

45. Maximum growth rate occurs in:
(a) senescent phase (b) lag phase
(c) exponential phase (d) stationary phase

Ans : OD 2018
Exponential is the 3rd phase where maximum growth rate occurs because of availability of food and requirements in plenty and there is no competition.
Thus (c) is correct option.

46. What do organisms in a population do in the lag phase?
(a) Grow at a slower rate
(b) Grow at a faster rate
(c) Death
(d) Tend to adapt

Ans : OD 2011
The lag phase is the initial phase of a growth curve in which the population increases slowly. Because the population tries to adopt the new environment.
Thus (d) is correct option.

47. Species-Area relationship is represented on a log scale as:
(a) hyperbola
(b) rectangular hyperbola
(c) linear
(d) inverted

Ans : DELHI 2015
The Species-Area relationship indicates that within a region the species richness increased with increasing area but upto a certain limit. Thus, the graph will be rectangular hyperbola for a wide variety of texa.
Thus (b) is correct option.

48. What does the J-shaped curve indicate?
(a) The J-shaped curve indicates that the resources are unlimited in a habitat.
(b) The J-shaped curve indicates that the resources are limited in a habitat.
(c) Resources have no connection with the habitat.
(d) None of the above.

Ans : COMP 2007
The J-shaped of growth curve for the population growth in a species indicates the exponential form of growth due to the favourable factors like unlimited resources.
Thus (a) is correct option.

49. Which of the following processes is responsible for fluctuation in population density?
(a) Mimicry (c) Hibernation
(b) Natality (d) Age structure

Ans : DELHI 2010
Natality has the greatest influence on a population's density. It is the number of individuals born in a population at a specific time. For humans, it is described as a number of individuals born per 1000 of the population per year.
Thus (b) is correct option.

50. Which letter is used to designate the immigration?
(a) A (c) S
(b) K (d) I

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Ans : SQP 2018
Immigration is designated by the letter 'I'.
Thus (d) is correct option.

51. What is a sigmoid growth curve called?
(a) Exponential growth curve
(b) Logistic growth curve
(c) Declining growth curve
(d) Interacting curve

Ans : FOREIGN 2011
The sigmoid growth curve is also called a logistic growth curve because it undergoes several phases and the population adapts to a particular condition and there is exponential growth so that the curve rises steeply upward.
Thus (b) is correct option.

52. How many phases does a logistic growth curve have?
(a) 5 (c) 1
(b) 8 (d) 4

Ans : COMP 2005
A logistic (sigmoidal) growth curve has 5 phases. They are lag phase, log phase, positive acceleration phase, negative acceleration phase, and stationary phase.
Thus (a) is correct option.

53. Which is the initial phase in logistic growth?
(a) Log phase
(b) Lag phase
(c) Declining phase
(d) Stationary phase

Ans : OD 2020
The initial phase of logistic growth is the lag phase in which the population increases slowly and tends to adapt the new environment.
Thus (b) is correct option.

54. What do organisms in a population do in the lag phase?
(a) Grow at a slower rate
(b) Grow at a faster rate
(c) Death
(d) Tend to adapt

Ans : DELHI 2014
In this phase, the population tries to adapt the new environment. Due to which population increases slowly.
Thus (d) is correct option.

55. Which is the second phase of the sigmoidal growth curve?
(a) Deceleration phase
(b) Log phase
(c) Exponential phase
(d) Stationary phase

Ans : SQP 2020
It is the logarithmic, exponential growth phase in which organisms multiply at a faster rate.
Thus (b) is correct option.

56. It is observed that, the species diversity decreases as we:
(a) move away from equator to poles.
(b) move towards equator from poles.
(c) move along the equator.
(d) move from deserts to rain-forests.

Ans : FOREIGN 2008
The biodiversity shows a latitudinal and altitudinal gradient. The species diversity decreases as we move away from the equator towards the poles with very few exceptions, tropics harbour more species than temperate or polar areas.
Thus (a) is correct option.

57. If a population of 50 Paramoecium present in a pool increases to 150 after an hour, what would be the growth rate of population?
(a) 50 per hour (c) 5 per hour
(b) 200 per hour (d) 100 per hour

Ans : COMP 2011
Population of Paramecium shows 100 per hour growth, i.e. two individuals are produced by one.
Thus (d) is correct option.

58. What would be the per cent growth or birth rate per individual per hour for the same population mentioned in the previous question (Question 58)?
(a) 100 (c) 50
(c) 200 (d) 150

Ans : OD 2005
Growth rate is 200% as one organism is producing two individuals at a time. (Refer to Question number-58)
Thus (b) is correct option.

59. A population has more young individuals compared to the older individuals. What would be the status of the population after some years?
(a) It will decline.
(b) It will stabilise.
(c) It will increase.
(d) It will first decline and then stabilise.

Ans : DELHI 2019
Population will increase after some years. Because high number of individuals will enter the

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reproductive age in coming years.
Thus (c) is correct option.

60. Which of the following would necessarily decrease the density of an population in a given habitat?
(a) Natality > Mortality
(b) Immigration > Emigration
(c) Mortality and Emigration
(d) Natality and Immigration

Ans : SQP 2010
Population density is the number of individuals present per unit volume/area at given time. Thus, mortality and emigration would necessarily decrease the density of a population in a given habitat due to loss of individual.
Thus (c) is correct option.

61. Amensalism is an association between two species where:
(a) one species is harmed and other is benefitted.
(b) one species is harmed and other is unaffected.
(c) one species is benefitted and other is unaffected.
(d) both the species are harmed.

Ans : FOREIGN 2005
In amensalism, one species is harmed and other is unaffected while options (A) indicates parasitism, option (C) indicates commensalism and option (D) indicates competition.
Thus (b) is correct option.

62. The primary reason for increase in human population is:
(a) the increase in agricultural production.
(b) the increase in birth rate and decrease in death rate.
(c) the improvement in medical technology.
(d) all of the above

Ans : COMP 2013
The growth of the population depends on the factors such as increases in birth rate, the decrease in death rate, availability of food and shelter, better medical facilities, better education facilities and standard of living.
Thus (d) is correct option.

ASSERTION AND REASON

DIRECTION : Each of these questions contains as Assertion following by Reason. Read them carefully and answer the question on the basis of following options. You have to select the one that best describes the two statements.

63. **Assertion :** Leaf butterfly and stick insect show mimicry to dodge their enemies.
Reason : Mimicry is a method to acquire body colour blending with the surroundings.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : DELHI 2020
Leaf butterfly is green in colour and stick insect also mimics in order to escape form the enemies and also to catch prey. The camouflaging mechanism helps the organism to get adapted to its surroundings. The Leaf butterfly is seen more near the leaves while the stick insect camouflages with its surroundings by living on the branches.
Thus (a) is the correct option

64. **Assertion :** Animals adopt different strategies to survive in hostile environment.
Reason : Praying mantis is green in colour which merges with plant foliage.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : SQP 2006
Animals blend with the surroundings or back ground to remain unnoticed for protection and aggression.
Thus (a) is the correct option

65. **Assertion :** The sex ratio of Kerala is highest in India.
Reason : In countries like India the population is increasing at a rapid rate.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

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Ans : COMP 2016
Kerala has a sin ratio of 1058 Indian population is growing with 1.2% animal change.
Thus (b) is the correct option

66. **Assertion :** Thick cuticle is mostly present in disease resistant plants.
Reason : Disease causing agents cannot grow on cuticle and cannot invade the cuticle.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : OD 2019
Disease resistant plants possess thick cuticle. Infectious organisms can not grow or invade cuticle.
Thus (a) is the correct option

67. **Assertion :** In sigmoid growth curve, population finally stabilizes itself.
Reason : Finally, the death rate increases than the birth rate.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : DELHI 2018
In sigmoid growth curve, finally, growth rate becomes stable because morality and natality rates become equal to each other and finally the population shows zero growth rate as birth rate equals death rate.
Thus (c) is the correct option

68. **Assertion :** Tropical rain forests are disappearing fast from developing countries such as India.
Reason : No value is attached to these forests because these are poor in biodiversity.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : FOREIGN 2009
Tropical rain forests have disappeared mainly due to man's activities. Due to over population in countries like India, rain forests are cut to make place available for man to live and build houses. To build buildings and factories man has incessantly cut down trees. This has caused the depletion of rain forests.
Thus (c) is the correct option

69. **Assertion :** Flora contains the actual account of habitat and distribution of plants of a given area.
Reason : Flora helps in correct identification.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : SQP 2006
Flora contains the actual account of habitat and distribution of plants of a given area. It provides the index to the plant species found in particular area.
Thus (b) is the correct option

70. **Assertion :** Species are groups of potentially interbreeding natural populations which are isolated from other such group.
Reason : Distinctive morphological characters are displayed due to reproductive isolation.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : FOREIGN 2009
A group of individuals resembling each other in morphological, physiological, biochemical and behavioural characters constitute a species. Such individuals can breed among themselves but cannot breed with members other than their own to produce fertile offsprings. New species are formed mainly due to reproductive isolation.
Thus (b) is the correct option

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Ans : DELHI 2010

(i) shark is eurythermal because it can tolerate and thrive in a wide range of temperature.

(ii) Polar bear is stenothermal s it can tolerate and thrive only in a narrow range of temperatures.

(iii) The thermal tolerance determines the geographical distribution of organisms; hence shark can live in a wide variety of places but the polar bear is restricted only to a narrow range (polar regions or ice-capped mountains), beyond which it cannot survive.

121. How are stenohaline animals different from euryhaline animals?

Ans : SQP 2011

The difference between stenohaline animals and euryhaline animals are as follows :

	Stenohaline animals	**Euryhaline animals**
(i)	These are the animals, Which show tolerance only to a narrow range of salinities.	These are the animals which can tolerate a wider range of salinities.
(ii)	Their distributional range is limited.	Their distribution shows a wide range.

122. Many fresh water animals cannot survive in marine environment. Explain.

Ans : FOREIGN 2019

(i) The fresh water animals cannot survive in marine environment due to osmotic problems.

(ii) Since the outer medium is highly saline, it may start losing water from the body.

(iii) Similarly, if a marine fish is placed in fresh water, there will be passive entry of water into the body.

(iv) Though the animals will start regulating the entry or exit of water, they cannot survive for long.

123. Why the plants that inhabit a desert are not found in a mangrove? Give reason.

Ans : COMP 2008

(i) Soil characteristics such as soil composition, grain size and aggregation determine the percolation and water-holding capacity of the soil.

(ii) The above features along with other parameters such as pH, mineral composition and topography determine the type of vegetation in a given area; hence plants which inhabit a rain forest cannot grow in a wetland.

124. Write the normal body temperature of humans. How is it maintained during summers?

Ans : OD 2005

It is 37° C or 98.4°F.

(i) During summer, when the outside temperature is higher than our body temperature, we sweat profusely.

(ii) The evaporation of sweat causes a cooling to maintain the body temperature.

125. When is an organisms called a 'conformer'? Explain with the help of an example?

Ans : DELHI 2018

When an organism cannot maintain a constant internal environment, but changes the temperature, osmotic concentration of body fluids, etc. with those of the ambient environment, it is called a conformer, e.g. freshwater fishes maintain the osmolarity of their body fluid.

126. Explain why very small animals are rarely found in polar region.

Or

Why are small birds like humming birds not found in polar regions? Explain.

Or

Why are small animals rarely found in the polar regions? Explain.

Or

Very small sized animals are rarely found in polar regions. Give two reasons.

Ans : OD 2010

(i) Heat loss or heat gain is a function of surface area.

(ii) Since small animals (like humming birds) have a larger surface area relative to their volume, they tend to lose body heat very fast, when it is cold outside.

(iii) They spend more energy to generate body heat through metabolism; considering the cost and benefit of maintaining a constant internal temperature, small animals (humming birds) are not found in polar regions.

127. Explain the response of all communities to environment over time.

Ans : COMP 2017

(i) Some organisms have evolved a constant internal environment and are able to maintain homeostasis by physiological or behavioural means.

(ii) Many animals and nearly all plants change their internal environment of the body with

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extreme temperature, reduced food availability, which in turn, delays the overall development.

87. Why do small mammals of the polar region have short ears and short limbs?

Ans : **FOREIGN 2015**

They have short ears and short limbs in order to minimise the heat loss in colder climates.

88. Mention the adaptations of mammals in polar seas.

Ans : **COMP 2019**

Mammals have a thick layer of fat, which is called blubber below their skin that acts as an insulator and reduces loss of body heat (e.g. seals).

89. How do fishes in Antarctica region remain active in sea water?

Ans : **OD 2005**

Fishes in Antarctica region accumulate anti-freeze proteins and glycerol, which lower the freezing point of body fluids, making them capable to survive in adverse conditions.

90. Why are mango trees unable to grow in temperate climate?

Ans : **OD 2016**

Mango trees are unable to grow in temperate climate because low temperature affects the kinetics of enzyme's functioning and through this basal metabolism activity and other physiological functions of the organism get affected.

91. Name a plant group which exhibits vivipary.

Ans : **DELHI 2019**

Vivipary means germination of seeds, while still attached to the tree. It is exhibited in halophytes.

92. Name the amino acid which is normally accumulated by xerophytes

Ans : **SQP 2009**

Amino acid normally accumulated by xerophytes is proline.

93. Provide an instance where the population size of species can be estimated indirectly, without actually counting them or seeing them.

Ans : **Delhi 2016**

Tiger population in natural parks is based on pugmarks.

94. What are the organisms that feed on plant sap and other plant parts called?

Ans : **FOREIGN 2020**

The organisms that feed on plant sap and other parts of plants are termed as phytophagous.

95. Why the Calotropis plants are not grazed by goats and cattle?

Ans : **COMP 2009**

Calotropis produces highly poisonous cardiac glycosides that can make the herbivore sick and hence, they are not grazed by goats and cattle

96. State Gause's competitive exclusion principle.

Ans : **OD 2014**

It states that two closely related species competing for the same resources cannot co-exist indefinitely and the competitively inferior one will be eliminated eventually by the superior one.

97. Mention how closely related species of warblers are able to co-exist in a competitive environment.

Ans : **SQP 2019**

Due to behavioural differences in their foraging activities.

98. State the type of interaction that exists between ticks and dogs.

Ans : **OD 2015**

Parasitism (Ectoparasite).

99. Name the two intermediate hosts on which the human liver fluke depends to complete its life cycle so as to facilitate parasitisation of its primary host.

Ans : **Delhi 2014**

The human liver fluke requires two intermediate hosts, i.e. freshwater snail and fish to complete its life cycle and facilitates parasitisation of its primary host

100. Give the name of two parasitic plants and two parasitic animals.

Ans : **FOREIGN 2011**

Parasitic plants are Cuscuta and Viscum and parasitic animals are mites and lice.

101. Name the interaction that exists between sucker fish and shark.

Ans : **Delhi 2016C, COMP 2015**

Sucker fish and shark is commensalism.

102. Name the type of association that the genus Glomus exhibits with higher plants.

Ans : **OD 2014**

Mycorrhizae/mutualism.

103. Name the association in which one species produces poisonous substance or a change in environmental conditions that is harmful to another species.

Ans : **DELHI 2015**

Amensalism

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VERY SHORT ANSWER QUESTIONS

71. State how the constant internal environment is beneficial to organisms.

Ans : COMP 2015

A constant internal environment allows all biochemical reactions and physiological functions to proceed with maximal efficiency and enhance the overall fitness of the species.

72. List any three ways of measuring population density of a habitat.

Ans : OD 2005

(i) Per cent cover.

(ii) Number caught per trap for fishes.

(iii) Pug marks or faecal pellets for tiger census.

73. Write the importance of measuring the size of a population in a habitat or an ecosystem.

Ans : SQP 2020

The study tells about the status of the population. A change in the population size can indicate the outcome of competition with another species, the impact of a predator or the effect of a pesticide application.

74. Mention the essential information that can be obtained by studying the population density of an organisms.

Ans : DELHI 2016

The population density tells us about the status of a species, i.e. the outcome of competition, impact of predation, or effect of pesticides, etc.

75. Explain with the help of an example how the percentage cover is a more meaningful measure of population size than mere numbers.

Ans : FOREIGN 2016

The per cent cover is a more meaningful measure of population size, in case of single huge banyan tree with a large canopy in an area where 200 small plants like Parthenium are present.

76. List any four abiotic components that lead to variations in the physical and chemical conditions of different habitats.

Ans : COMP 2015

Temperature, water, light and soil.

77. What do we call the species that can tolerate narrow range of temperature?

Ans : OD 2005

Stenothermal organisms.

78. Which of the two, stenothermals or eurythermals, show wide range of distribution on earth and why?

Ans : DELHI 2018

Eurythermal organisms, e.g. birds show wide range of distribution because they can thrive in wide range of temperature.

79. Between amphibians and birds, which is more likely to be able to cope with global warming? Give reason.

Ans : SQP 2019

Birds are more likely able to cope with global warming as they can tolerate a wide range of temperatures (eurythermals).

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80. Name two 'photoperiod' dependent processes, one each in plants and in animals.

Ans : FOREIGN 2009

Flowering in plants and migration in animals.

81. What determines the type of benthic animals in an aquatic ecosystem?

Ans : COMP 2011

The sediment characteristics determine the benthic animals in an aquatic ecosystem.

82. Mention the factors that determine the water holding capacity of soil.

Ans : OD 2005

Soil composition, grain size and aggregation.

83. Aquatic animals that change the osmotic concentration of their body fluids according to the environment are known by which name?

Ans : DELHI 2009

Osmoconformers.

84. Name the National Park in India where migratory birds arrive in winter from Siberia.

Ans : SQP 2015

Keoladeo National Park.

85. Mention how do bears escape from stressful time in winter.

Ans : Delhi 2013C

Bears escape from stressful time in winter by going into hibernation, also known as winter sleep.

86. Give an example of an organism that enters 'diapause' and why.

Ans : Delhi 2014

Many zooplanktons in lakes and ponds enter diapause. They enter into diapause due to some adverse environmental conditions such as drought,

(i) The individuals may have births and deaths; while the populations have births rates and death rates. In addition to it, in populations, these terms refer to per capita births and deaths and express the changes either increase or decrease in numbers of the members in a population.

(ii) Sex ratio is another attribute of a population i.e., male and female ratio in a population say 60% males and 40% females.

(iii) The population consists of the individuals of different ages. It is shown by pyramids which show growing, stable and declining populations.

(iv) The size of a population is called its density (N).

116. Distinguish between Hibernation and Aestivation

Ans : SQP 2019

Difference between Hibernation and Aestivation are as follows :

	Hibernation	**Aestivation**
1.	The bears go into hibernation during winter to avoid stress by escaping in time.	The snails and fish go into aestivation during summer to avoid heat related problems and dessication also.
2.	The frogs undergoes muddy water and suspends its metabolic activities in winter season.	The frog also undergo aestivation in summer.

117. Distinguish between the Ectotherms and Endotherms.

Ans : FOREIGN 2015

Difference between Ectotherms and Endotherms are as follows :

	Ectotherms	**Endotherms**
1.	These are called **poikilothermal** animals having a variable temperature. Their body temperature fluctuates in environmental temperature and are **cold-blooded**.	They are known as the **homeothermic** animals having the same temperature. So they are called **warm blooded**.
2.	**Examples** are most invertebrates and chordates like lizard except birds and **mammals**.	**Examples** are **birds** and **mammals** that generate heat within body.
3.	Ectothermic animals cannot regulate their body temperature by physiological means.	They have high rate of oxidative metabolism.

118. Define population and community.

Ans : OD 2005

(i) **Population :** It refers "to the individuals of one species that live in groups in a well defined geographical area, share or compete for same resources and potentially interbreed."
Example : Teak wood trees in a forest tract and bacteria in a culture plate.

(ii) **Biotic Community of Community :** It is "an association of a number of different interrelated populations belonging to different species in a common environment, which can survive in nature".
The plants and animals in a lake constitute communities.

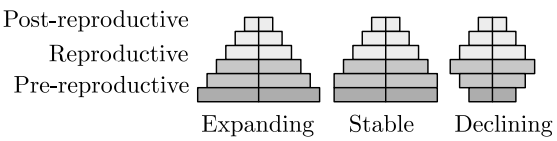
119. List any three characteristics of a population and explain

Ans : COMP 2008

(i) **Birth rate and death rate :** These rates express change in number may be increase or decrease with respect to members of a population.

(ii) **Sex ration :** A population has percentage of males and females, e.g. 60% of males and 40% of females.

(iii) **Age structure :** At any given time, a population has individuals of different ages. The age pyramid reflects the status of the population.
(a) Whether growing
(b) Stable or
(c) Declining



120. Shark is eurythermal, while polar bear is stenothermal. What is the advantage the former has and what is the constraint the latter has?

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104. Why did the Abingdon tortoise in Galapagos island become extinct?

Ans : **DELHI 2018**

Due to greater browsing efficiency of goats that were introduced in Galapagos Island.

105. What are those species called that can tolerate wide range of salinity?

Ans : **SQP 2011**

Eurythermal.

106. What would be the growth rate pattern when the resources are unlimited?

Ans : **FOREIGN 2015**

Exponential growth.

107. Name the association between fungus and roots of higher plants.

Ans : **COMP 2020**

Mutualism.

108. What do you understand by ecophene?

Ans : **OD 2005**

Variety of phenotypes observed in a population.

109. State the term used for shade plants.

Ans : **DELHI 2009**

Sciophytes.

SHORT ANSWER QUESTIONS

110. What are the forms total population? Write in brief.

Ans : **OD 2015**

The sum of individuals of a species living in a specific area which can interbreed naturally to produce fertile offspring is called as population. Together, they act as a unit of biotic community. Total population sampling is a type of purposive sampling technique where we choose to examine the entire total population that have a particular set of characteristics.

Various attributes that can be used for population sampling are

1. Traits eg gender, occupation etc.
2. Attitudes eg supporters of a certain political party etc.
3. Experience eg an assault, etc.

111. Explain symbiosis or mutualism by giving one example.

Ans : **OD 2011**

Mutualism is a type of symbiotic relationship where both species benefit from the interaction. An example of mutualism in the relationship between the Egyptian plover and the crocodile. In the tropical regions of Africa the crocodile lies with its mouth open. The plover flies into its mouth and feeds on bits of decaying meat stuck in the crocodile teeth cleaned. The crocodile does not eat the plover instead, he appreciates the dental work. The plover eats a meal and the crocodile get his teeth cleaned.

112. How is diapause different from hiberantion?

Ans : **SQP 2015**

Difference between Diapause and Hibernation are as follows :

	Diapause	**Hiberantion**
(i)	**Example :** The zoo-plankton species in lakes and ponds show it under unfavourable conditions.	**Example :** Bears in winter avoid stress by escaping in time.
(ii)	It is the stage of suspended development.	The bears if cannot move or migrate go into hibernation. Frogs also hibernate in winter.

113. Define phenotypic adaptation. Give one example.

Ans : **OD 2005**

Phenotypic Adaptation : These are defined "as the morphological adaptations which enables an organism to survive and reproduce in its habitat. **Example :** The desert plants have thick cuticle on their leaf surfaces; leaves are reduced to spines in Opuntia.

114. Most living organisms cannot survive at temperature above 45°C. How are some microbes able to live in habitats with temperatures exceeding 100°C?

Ans : **COMP 2010**

In most animals, the metabolic reactions occur in a narrow range of temperature e.g., human 37°C . The microbes live in habitats with temperatures exceeding 100°C because they are adapted to such temperature, the extreme environment showing biochemical adaptations.

115. List the attributes that populations but not individuals possess.

Ans : **DELHI 2016**

The populations have some attributes which the individuals do not possess. **Examples** are :

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those of the external environment, i.e., they are conformers.

(iii) Some organisms move away temporarily from the stressful conditions in their habitats and return when the stressful period is over.

(iv) Some animals suspend their metabolic activities and avoid stress by escaping in time; hibernation and aestivation are examples of such suspension.

128. Bear hibernates, whereas some species of zooplanktons enter diapause to avoid stressful external conditions. How are these two ways different from each other?

Ans : **OD 2005**

Hibernation	Diapause
Hibernation is the process of spending winter/extreme cold conditions in a dormant condition by some animals, to escape in time.	It is a stage of suspended development shown by zooplanktons under unfavourable conditions.

129. Some organisms suspend their metabolic activities to survive in unfavourable conditions. Explain with the help of any four examples.

Ans : **SQP 2010**

(i) Bacteria, fungi and lower groups of plants produce various kinds of thick walled spores, which help them to survive unfavourable conditions; they germinate when favourable conditions return.

(ii) In higher plants, seeds and certain vegetative reproductive structures serve as means to tide over the stress periods.

(iii) Animals which are not able to migrate avoid the stress by escaping in time during extreme winters/cold conditions (hibernation as in bears) and during extreme hot conditions (aestivation, as in snails)

(iv) Many zooplanktons in lakes and ponds enter diapause, a stage of suspended developments.

130. Mention the adaptation the kangaroo rat in North American deserts has, to survive in the absence of an external source of water

Ans : **OD 2016**

(i) It is capable of meeting all its water requirements through its internal oxidation of fat in which water is a by product.

(ii) It can concentrate its urine, so that only minimal volume of water is removed during excretion of wastes.

131. Mention four adaptive features that help cacti survive in xeric environment.

Ans : **DELHI 2010**

(i) The leaves are reduced to spines.

(ii) The stem is green, flattened, spongy and takes over the function of photosynthesis.

(iii) A thick cuticle prevents loss of water.

(iv) They have a special photosynthetic mechanism (CAM) that enables their stomata to remain closed during day and opening during night.

132. How does our body adapt to low oxygen availability at high altitudes?

Ans : **FOREIGN 2011**

The mountain dwellers have

(i) higher red blood cell count.

(ii) higher haemoglobin content.

(iii) faster breathing rate.

(iv) decreased binding capacity of haemoglobin.

133. How do desert lizards cope with temperature variations in their environment? Explain.

Ans : **FOREIGN 2018**

(i) Desert lizards cope with the temperature variations in their habitat by behaviour means.

(ii) They bask in the sun and absorb heat when their body temperature drops below the comfort zone.

(iii) They move into the shade when the temperature starts increasing.

134. Differentiate between population size and population density.

Ans :

Population size	Population density
Population size refers to the number of individuals in a given area at a given time.	Population density refers to the number of individuals per unit area at a given time.

135. Explain the defence mechanisms evolved in preys to avoid overpopulation of their predators.

Ans : **COMP 2010**

(i) Certain insect species and frogs have camouflage (cryptic colouration) to avoid detection by their predators.

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	Eurythermal animals	**Stenothermal animals**
(i)	These are the animals which can tolerate a wide range of temperature.	These are the animals which can tolerate only a narrow range of temperatures.
(ii)	They show a wide geographical distribution.	They are restricted in their geographical.
	e.g. Human beings, shark.	e.g. Polar bear, seal.

148. Explain any two alternatives by which organisms can overcome stressful environmental conditions.

Ans : **OD 2016**

Migration and suspension of physiological functions are the methods followed by organisms.

(a) Migration : The Organisms moves away temporarily from the stressful habitat to a more hospitable area and return to the original habitat when the stressful conditions become over.

(b) Suspending : Hibernation or escaping in time the extreme cold or winter conditions is shown by bears.

Aestivation or escaping in time the extreme summer related problems is shown by snails.

149. In certain seasons we sweat profusely while in some other season we shiver. Explain.

Ans : **OD 2011**

(i) In summer, when the outside temperature is more than out body temperature, we sweat profusely; when the sweat evaporates, there is a cooling effect, which brings down the body temperature.

(ii) In winter, when the outside temperature is much lower than our body temperature, we shiver, which is a kind of exercise that produces heat and increase the body temperature.

(iii) Thus, we maintain a constant body temperature, both in summer and winter.

150. Water is very essential for life. Write any three features both for plants and animals, which enable them to survive in water-scarce environment.

Ans : **COMP 2011**

Plants :

(i) Desert plants have a thick cuticle on their leaf surface.

(ii) Their stomata are arranged in deep pits (sunken) to minimise water loss through transpiration.

(iii) Leaves are reduced to spines and the photosynthetic function is carried out by thick, fleshy flattened stems (phylloclades).

Animals :

(i) Animals like kangaroo rats are capable of meeting the water requirements through internal oxidation of fat.

(ii) They can concentrate their urine so that minimal volume of water is excreted.

(iii) Animals like snails undergo aestivation during hot summers.

151. List three symptoms of high altitude sickness and state three adaptations to overcome it.

Ans : **OD 2005**

Symptoms include :

(i) Nausea

(ii) Fatigue, and

(iii) Heart palpitations.

Adaptations are :

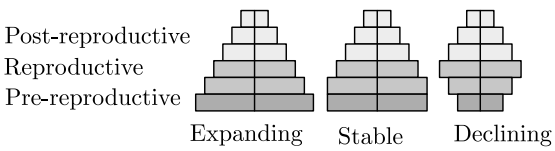
(i) Increasing breathing rate

(ii) Increased production of red blood cells

(iii) Decreasing the binding capacity of haemoglobin.

152. Represent diagrammatically three kinds of age-pyramids for human populations.

Ans : **DELHI 2015**



153. How do organisms cope with stressful environmental conditions, which are localised or of short duration?

Or

How do organisms manage with stressful conditions existing in their habitats for short duration? Explain with the help of one example each.

Ans : **FOREIGN 2020**

Organisms overcome the stressful conditions that are of short duration in the following ways :

(i) The organisms migrate, i.e. they move away from the stressful habitat to a more hospitable are and return to their habitat when the stressful period is over, e.g. Birds

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	Commensalism	Predation
(i)	It is an interspecific interaction in which one of the species is benefited and the other is neither benefited and harmed.	It is an interspecific interaction in which the large animal, called predator, kills and consumes the smaller animal, called prey.
(ii)	No species is harmed.	One species is harmed.
(iii)	It is not a conduit for energy transfer	It is a conduit for energy transfer.

143. What is mutualism? Mention any two examples, where the organisms involved are commercially exploited in agriculture.

Ans : COMP 2011

(i) Mutulasim is the interspecific interaction in which both the partners are mutually benefitted.

(ii) The Rhizobium bacterium that makes mutualistic association with the leguminous roots is commercially cultured and used in the field to make association with the roots of legumes.

(iii) Glomus, a genus of fungus is made available to make mycorrhizae with roots of higher plants.

144. Describe the mutual relationship between fig tree and wasp and comment on the phenomenon that operates in their relationship.

Or

Why are a fig tree and its partner wasp considered a good example of mutualism?

Or

Certain species of wasps are seen to frequently visit flowering fig trees. What type of interaction is seen between them and why?

Or

Explain mutualism with the help of an example.

Ans : SQP 2018

(i) It is a case of mutualism because both the fig tree and the wasp are benefited by this interaction.

(ii) The female wasp uses the ovary as a site for oviposition and the developing seeds within the fruit for nourishing the larvae.

(iii) The fig inflorescene is pollinated while the wasp is searching for the suitable place for egg-laying.

145. How does the Mediterranean orchid, Ophrys ensure its pollination by bees?

Ans : FOREIGN 2011

In the flowers of Ophrys, one petal resembles the female of a bee species in size, colour, markings, etc.

(i) The male bee perceives it as a female and pseudocopulates with it.

(ii) During the process, the pollen grains from the anthers become dusted on the body of the bee.

(iii) When the bee is attracted to another flower of this orchid species, the process is repeated and the pollen grains from the body of the bee get dusted on the stigma, i.e., pollination is achieved.

146. Differentiate between commensalism and mutulasim by taking one example each from plants only.

Ans : SQP 2007

The difference between commensalism and mutulasim are as follows :

Mutualism	Commensalism
It is an interspecific interaction, in which both the partner species are benefited.	These are the animals which can tolerate only a narrow range of temperatures.
e.g. In the association between Rhizobium bacterium and leguminous plants, the bacterium fixes atmospheric nitrogen and makes it available to the leguminous plants; in return, it gets food and shelter from the root.	e.g. In the association between an orchid plant growing on a mango tree, the orchid plant gets shelter on the mango tree. but the mango tree is neither benefited nor harmed

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147. How are eurythermal animals different from stenothermal animals? Give an example of each.

Ans : COMP 2019

The difference between eurythermal animals and stenothermal animals are as follows :

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(ii) Some animals are highly distasteful to their predators, e.g., monarch butterfly accumulates a chemical by feeding on a poisonous weed during its caterpillar stage.

(iii) Some prey are poisonous and hence are avoided by predators.

(iv) Plants have developed thorns and spines as defence mechanism against browsing animals.

(v) Some plants produce certain chemical which affect the metabolism of the herbivores.

136. Besides acting as 'conduits' for energy transfer across trophic levels, predators play other important roles. Justify.

Ans : **SQP 2019**

(i) Predators help in maintaining species diversity by reducing the intensity of competition among the competing prey species.

(ii) Predators keep the they population under control and thereby prevent the ecosystem instability.

137. How is predation different from competition?

Ans : **COMP 2007**

The difference between predation and competition are as follows :

	Predation	**Competition**
(i)	It is an interspecific interaction where one animal, called predator, kills and consumes the other animal, called prey	It is the type of interaction either among the individuals of the same species or of different species, which compete for food or shelter.
(ii)	One is benefited and the other is harmed.	Both the partners are affected.

138. List any four parasitic adaptations in a parasite.

Or

List any four features evolved in animals to adapt to their parasitic mode of life.

Ans : **OD 2018**

(i) Loss of unnecessary sense organs.

(ii) Presence of hooks/adhesive organs and suckers.

(iii) Loss of digestive system.

(iv) High reproductive capacity.

139. Differentiate between predators and parasites.

Ans : **DELHI 2011**

The differentiate between predators and parasites are as follows :

	Predators	**Parasites**
(i)	They are the larger animals which kill and consume the smaller animal (prey).	These are the smaller organisms (than the host) and do not kill or consume the host.
(ii)	They are highly mobile.	They are less mobile or non-mobile.
(iii)	Their reproductive capacity is slow.	Their reproductive capacity is high.
(iv)	They do not live on/inside the body of the prey.	They live on/inside the body of the host.

140. Mention the characteristics found in endoparasites.

Ans : **DELHI 2020**

Characteristics of endoparasites are as follows :

(i) Loss of unnecessary sense organs.

(ii) Presence of adhesive organs like hooks and suckers.

(iii) Loss of digestive system.

(iv) Mechanism to counteract and neutralise the digestive juices.

141. Why do clown fish and sea-anemone pair up? What is this relationship called?

Or

The 'clown' fish lives among the tentacles of sea anemone. What is this interaction between them called and why?

Ans : **SQP 2010**

The sea anemone has stinging tentacles and the clown fish gets protection from predators which stay away from the stinging tentacles; sea anemone does not derive any benefit from this interaction.

This relationship is called commensalism, as one of the partners (clown fish) is benefited and the other (sea anemone) is not benefited.

142. How is commensalism different from predation, though one of the partners is benefited in each of them?

Ans : **FOREIGN 2008**

The difference between commensalism and predation are as follows :

from Siberia and other cold countries migrate to Bharatput Santuary in Rajasthan.

(ii) Animals which cannot migrate avoid stress by escaping in time.
  (a) They show hibernation, i.e., escaping in time during winters, e.g., bears and frogs.
  (b) They may go into aestivation, i.e. escaping in time to avoid summer-related problems, e.g. snails and fish.
  (c) Zooplanktons enter diapause, a state of suspended development.

(iii) In bacteria, fungi and lower groups of plants, various types of thick-walled spores are formed; they germinate under suitable conditions.

154. How does an age pyramid for human population at given point of time helps the policy-makers in planning for future.

Ans : **SQP 2019**

An age pyramid is the graphic representation of the age distribution, i.e. per cent individuals of a given age or age group, in a population. The shape of the age pyramid indicates the growth status of the population, i.e. whether it is

(a) Expanding/growing, with more individuals in the pre-reproductive age.

(b) Stable with number of individuals in the pre-reproductive age equal to that in the reproductive age and

(c) declining, with less number of individuals in the pre-reproductive age than that in reproductive age.

Accordingly, the policy-makers can plan for the future.

155. Explain brood parasitism with the help of an example.

Ans : **FOREIGN 2011**

Brood parasitism refers to the phenomenon in which a (parasitic) bird species lays its eggs in the nest of another (host) bird species and lets the host incubate them. The eggs of the parasitic bird must have evolved resemblance to the eggs of the host in size and colour to reduce the chances of the host bird detecting the foreign eggs and ejecting them from the nest, e.g. the cuckoo lays its eggs in the nest of a crow.

156. Differentiate between parasitism and competition, giving one example of each. State the common characteristics they share.

Ans : **COMP 2008**

The difference between parasitism and competition are as follows :

	Parasitism	**Competition**
(i)	It is the interspecific interaction in which one species, called parasite takes food and shelter from another living organism, called host and in due course of time, damages or kills the host.	Competition is a type of interaction either among the individuals of the same species (intraspecfic) or between individuals of different species (interspecific) for the basic needs.
(ii)	One is benefited and the other is damaged/killed.	Both are harmed.

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157. Explain the impact of these components on the distribution of organisms in different habitats.

Ans : **OD 2018**

(a) Temperature influences the kinetics of enzymes and thereby the metabolism and other physiological functions of the organisms. Organisms may be eurythermal and can tolerate a wide range of temperatures or stenothermal and can tolerate only a narrow range of temperatures.

(b) Water is important to sustain life and productivity and distribution of plants is dependent on water. Freshwater form cannot thrive in sea water and vice versa.

(c) Light influences photosynthesis of plants. Light also influences the flowering in plants and timing of foraging, reproduction and migratory activities of animals. Aquatic plants occupy different depths depending on their pigments and the light available.

(d) Soil influences vegetation by the water holding capacity, topography and its composition.

158. List the different ways by which organisms cope or manage with abiotic stresses in nature. Explain any three ways listed.

Ans : **FOREIGN 2016**

The different ways to cope with abiotic stresses are :

(i) **Regulation :** Some animals maintain homeostasis by physiological means that ensure a constant body temperature constant osmolarity of body fluids, etc.; mammals maintain a constant body temperature.

170. In what way prey species benefited by their predators? Do scavengers which feed on the same species have the same effect? Explain.

Ans : DELHI 2010

The predators control the population of the species on which they prey. This helps in checking the number of prey in limit. In the absence of predators the number of the species being prayed would increase considerably. Thus there would be great competition among themselves for various requirements of life. The predator-prey relationship brings a balance in the nature.

In the case of scavengers, the effect is different. Scavengers eat up the bodies of dead animals. In this way they clean up the atmosphere and help in circulating the material in the environment.

LONG ANSWER QUESTIONS

171. Explain the effects of climatic factors on population.

Ans : OD 2014

A set of individuals of a particular species, found in particular geographical area is called population. The effect of climatic factors on population are as follows :

1. **Temperature and Light :** Temperature of the air and water affect animals, plants and humans in ecosystems. A rise in temperature has the potential to change the way a living thing develops, because it changes the metabolic rate of the organism. All living organisms have a tolerance level for temperature range. For example, a human being would die if he stood in minus 50 degree temperatures for any length of time. Light exposure often affects the temperature. Areas with direct sunlight are warmer.
2. **Wind :** The wind speed and direction affects the temperature and humidity of an area. Very high wind speeds, often in mountainous areas, may lead to stunted plant growth and limit the types of life that can thrive in the area. Wind also carries seeds and aids pollination, spreading life. This lets plant forms travel out of a contained area.
3. **Humidity :** Atmospheric moisture in the form of invisible vapour is known as humidity. Humidity is greatly influenced by intensity of solar radiation, temperature, attitude, wind, water status of soil etc. Low temperature causes higher relative humidity by decreasing the capacity of air for moisture. Processes such as transpiration, absorption of water etc. are influenced by atmospheric humidity, Humidity, thus, plays an important part in the life of plants and animals.
4. **Rainfall :** The rainfall provides water to plants and animals. Annual rainfall determines the types of vegetation in any region. Evergreen forests are found in tropical regions due to heavy rainfall throughout the year. Grasslands are found in such regions where there is heavy rainfall during summer and low rainfall during winter.

   Different regions of the earth receive, different quantity of rainfall depending upon the geographical features and the availability of moisture laden winds. The quantity, duration and intensity of rainfall regulate plant life.

172. Write a short note on :

(i) Adaptations of desert plants and animals.
(ii) Adaptations of plants to water scarcity.
(iii) Behavioural adaptations in animals.
(iv) Importance of light to plants.
(v) Effect of temperature or water scarcity and the adaptation of animals.

Ans : OD 2005

(i) **Desert plants :**
- (a) Plants have a very deep root system.
- (b) Stems become modified into fleshy and spongy structures or they become expanded, flat and green (Phylloclade) to store water and carry out photosynthesis.
- (c) Leaves are either small or have leathery surface, waxy cuticle and sunken stomata.
- (d) Leaves are modified into spines in cacti.

Desert animals :
- (a) They burrow into the soil and hide to escape from the above-ground heat.
- (b) Desert lizards manage to deal with high temperature by keeping the body temperature fairly constant by behavioural means.
- (c) Kangaroo rats are capable of meeting their water requirements (up to 90%) from the metabolic water produced by oxidation of fat.

  They also concentrate their urine to a minimal volume.

(ii) **Adaptations in plants to water scarcity**
- (a) The plants develop a thick cuticle to check transpiration.
- (b) They have sunken stomata.

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adaptation (morphological, physiological or behavioural) that help them to survive in such odd climate. Some of these are

1 Leaves are reduced, scale-like, appearing only for a brief period sometimes modified into spines.
2 Foliage leaves are usually thick, fleshy and succulent and coated with waxy cuticle; glazed to reflect light.
3 Have well developed and extensively long root system.
4 Stems are mostly stunted woody, dry, hard and covered with thick bark. In some plants, it covered with spines, e.g. Opuntia.
5 Stomata are sumken and open during night only. Succulents are adapted to perform CO_2 fixation by Crassulacean Acid Metabolism (CAM).
6 In grasses, the leaves roll during dry weather to reduce surface exposed for transpiration.

164. Write about hydrophytes, xerophytes and mesophytes with suitable examples.

Ans : **OD 2015**

1. **Hydrophytes :** These are the plants adapted to survive in water (either completely or partially submerged or floating) such plants have roots reduced in size with the absence of root hair and cap, Absorption takes place by general body surface. The is stomata either absent or non-functional, e.g. Hydrilla, Vallisneria, Pistia, Salvinia, etc.
2. **Mesophytes :** These are the plants adapted to grow in moderate amount of water as found in temperate and tropical regions such plants have large rigid stem. Well developed mechanical and vascular tissues, have well developed root system with root hairs present. e.g. garden plants, cultivated or farm crop plants.
3. **Xerophytes :** Such plants are adapted to survive in dry or a xeric conditions having scarcity of water. They are characterised by deep root system, bushy appearance, leaves reduced to spines. Thick cuticle, deep sunken stomata, e.g. Acacia, Prosobis, Zizyphus, etc.

165. Which key elements lead to variation in the physical and chemical conditions of different habitats?

Ans : **DELHI 2018**

The most important elements are temperature, water, light and soil, But the physico-chemical or abiotic components alone do not characterise the habitat of organisms. The habitat also includes biotic components like parasites, pathogens, predators and competitors with which they interact regularly. Organisms have evolved adaptations to maximise their survival and reproduction in their habitats.

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166. Which key elements lead to variation in the physical and chemical conditions of different habitats?

Ans : **SQP 2011**

The most important elements are temperature, water, light and soil, But the physico chemical or abiotic components alone do not characterise the habitat of organisms. The habitat also includes biotic components like parasites, pathogens, predators and competitors with which they interact regularly. Organisms have evolved adaptations to maximise their survival and reproduction in their habitats.

167. How migration help in survival in stressful habitat.

Ans : **FOREIGN 2019**

The organisms can move away from the stressful habitat to a more hospitable area for some short period. They can return back when stress period is over. Many animals especially birds undertake long distance migration in winters. They come to our country from Siberia and other extremely cold regions. After staying for some period, they go back to their original homes.

168. How escape in time helps the animals to survive?

Ans : **COMP 2015**

The animals who are unable to migrate, may avoid the stress by escaping in time for example, bears going into hibernation during long winters. Some snails and fishes go into aestivation to avoid summer related stress and desiccation. Many zooplankton species go to diapause in lakes and ponds the stage of suspended development.

169. How desert plants adapt in dry and xeric conditions?

Ans : **OD 2018**

Many desert plants have a thick cuticle layer on the surface of their leaves. They also have deep seated sunken stomata. These features reduce their rate of transpiration and minimize water loss. They also possess special photosynthetic pathway the CAM. It helps them to keep their stomata close during day when temperature is very high. Some plants like cacti have no leaves or their leaves are reduced to spines. The photosynthesis in these plants is done by green flattened stem.

(ii) **Conformation :** Those animals called conformers, which cannot maintain homeostasis, change their body temperature or osmolarity of body fluids according to the ambient environment.

(iii) **Migration :** If the stressful condition is localised, animals move away temporarily from the stressful environment to more hospitable area and return when the stressful conditions are over.

(iv) **Suspending :** Some animals avoid the stress by escaping in time; bears go into hibernation during winter and snails go into aestivation in summer.

159. Explain giving reasons why the tourists visiting Rohtang Pass or Mansarovar are advised to resume normal 'active life' only after a few days of reaching there.

Ans : **DELHI 2015**

These are places at high altitudes, i.e. 73,500 m above sea level.

(a) Tourists may experience altitude sickness, whose symptoms include nausea, heart palpitation and fatigue.

(b) Since the atmospheric pressure is low at high altitude, the body does not get enough oxygen.

(c) But gradually, the body gets acclimatised and stops experiencing altitude sickness.

160. It is impossible to find small animals in the polar regions. Give reasons.

Ans : **SQP 2011**

Heat loss or gain is a function of the surface area of the body.

(a) Small animals have a larger surface area relative to the volume of the body; hence, they tend to lose body heat very fast, when it is cold outside.

(b) They have to spend more energy to generate body heat through metabolism; hence small animals are not found in polar regions.

161. How do parasites harm the host? Name the two categories of parasites and differentiate between them. Give an example for each.

Ans : **COMP 2017**

Parasites harm the hosts in the following ways :

(i) Reduce the survival of the host.

(ii) Reduce the growth and reproductive rate.

(iii) Ender the host vulnerable to its predators by making them physically weak.

The two categories of parasites are :

(1) Ectoparasites and (2) Endoparasites.

	Ectoparasites	**Endoparasites**
	Ectoparasites are those parasites which depend on the external surface of the host.	Endoparasites are those which take shelter within the body of host in the organs like intestine, liver lungs, blood cells, etc.
	e.g. 1. Head-lice on humans 2. Ticks on dogs' skin 3. Marine copepods on fish 4. Cuscuta on hedge plants.	e.g. 1. Tapeworm (Intestine) 2. Liverfluke (Liver) 3. Plasmodium (Red blood cells, Liver)

162. How is amensalism different from parasitism and competition? Give an example for each.

Ans : **OD 2005**

	Amensalism	**Parasitism**	**Competition**
(i)	It is an interspecific in which one is harmed and the other is neither benefited nor harmed.	It is an interspecific interaction in which one species, called parasite takes shelter and food from another living organism, called host and in due course of time damages the host.	It is a type of interaction either among the individuals of same species (intra-specific), or between individuals of different species (interspecific) , for the same esources.
(ii)	Neither of the partners is benefited	One of the partners is benefited.	None of the partners is benefited.

163. Write the ecological adaptations among xerophytic plants.

Ans : **OD 2017**

The plants that grow in dry climates are known as xerophytes. These plants bears certain ecological

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(c) The leaves are modified into spines or scales.
(d) The stem becomes a phylloclade and helps in photosynthesis and storage of food and water.
(e) Some have a special photosynthetic pathway, Crassulacean Acid Metabolism the enable's their stomata, open at nigh and closed during day.

(iii) **Behavioural adaptations in animals**

to cope up with the extremes in their environment of unfavourable conditions, they show modified behaviour to suit the environmental conditions.
(a) Migration is an example ,where the animal temporarily moves to a less stressful environment.
(b) The desert lizards bask in the sun and absorb heat when the body temperature drops below the comfort zone. But when temperature starts to increase they move into shade.

(iv) **Importance of light to plants**
(a) Light is important to plants for photosynthesis and preparation of food materials.
(b) Duration of light determines the flowering and fruiting in many plants.
(c) Availability of light is associated with temperature and temperature determines the functioning of enzymes.

(v) **Effect of temperature**
(a) Temperature affects the enzyme kinetics and hence, the physiological function-animals have developed tolerance over a wide range of temperatures (eurythermal) or only for a narrow range of temperatures (stenothermal).
(b) The levels of their thermal tolerance determine their geographical distribution.

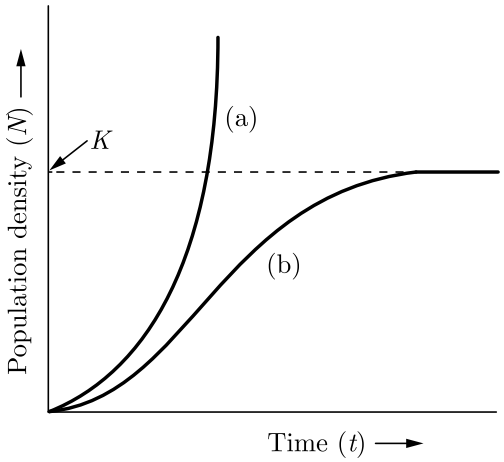
(vi) **Effect of water scarcity**
(a) In the absence of an external source of water, the kangaroo rat is capable of meeting all its water requirements through its internal fat oxidation.
(b) It also concentrates its urine, so that animal volume of water is used to removed excretory products.

173. (i) Explain with the help of a graph, the population growth curve when resources are : (a) limiting and (b) not limiting.

(ii) 'Nature has a carrying capacity for a species.' Explain.

Ans : **OD 2024, SQP 2008**

(i)



(a) When resources are limiting, the population growth curve is Sigmoid and it is represented by the equation :

$dN/dt = rN\left(\frac{K-N}{K}\right)$, where

N = Population density at time t

r = Intrinsic rate of natural increase

K = Carrying capacity

(b) When resources are not limiting, the growth curve is J shaped and is represented by the equation :

$dN/dt = rN$ or

$N_t = N_0 e^{rt}$, where

N_t = Population density after time t

N_0 = Population density at time zero

r = intrinsic rate of natural increase

e = The base of natural logarithm (2.71828)

(ii) Carrying capacity refers to the maximum number of individuals of a species (population) that an environment can support at a given time.
(a) In nature, the given habitat has enough resources to support a maximum possible number, beyond which no further growth is possible.
(b) When the population density reaches the carrying capacity, the growth curve becomes stationary and hence, sigmoid.
(c) The sigmoid or logistic growth curve is more realistic as the resources for growth of populations are finite and become limiting sooner or later.

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174. List the various abiotic environmental factors.

Ans : **OD 2008**

Various Abiotic Environment Factors : Some main abiotic factors are given below :

(i) **Temperature :** It varies from place to place. It decrease from **Equator** towards **poles**. In **polar** region, it is subzero. At high **altitudes**, it may be$>$ 50°C in tropical deserts in summer season. Mango does not grow in **Canada. Snow leopards** are not found in Kerala. The enzymes becomes inactive high temperatures.

(ii) **Water :** It is most essential ecological factor. In affects the life of organisms. It may be fresh water or salty water (marine). In deserts, water is scarce, so the organisms have devices to conserve water. For aquatic life pH is important. Salinity affects sea life. **Fresh water fishes** may not live in salty water due to osmotic problems.

(iii) **Light :** It affects the life of plants and animals. Photosynthesis occurs only in light. Light is a source of energy. Constantly overshadowed plants like herb and small shrubs live under tall tree's canopy and adapted to low light. Light affects the life of animals. They may be diurnal or nocturnal. Light intensity and duration affects many functional aspects of plants and animals.

(iv) **Soil :** The properties and texture of soil affects the life of organisms. Plants depend on soil water. Soil composition and water holding capacity determine the vegetation of an area. The benthos live in sediments of aquatic environment.

(v) **Response to Abiotic Factors :** The constant internal environment of body is maintained by homeostasis. By physiological mean, one can ensure constant body temperature and osmotic concentration. These may be temperature regulation and osmotic regulation. The mammals live well in Sahara or in Antarctica.

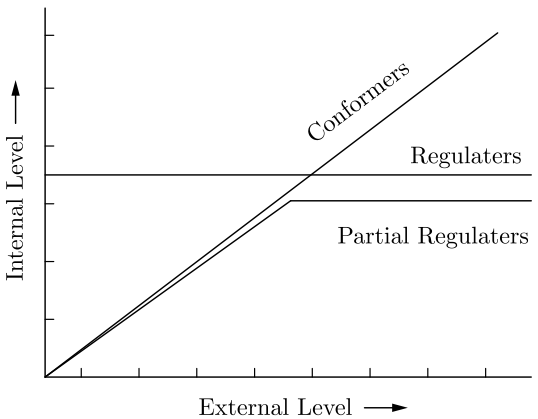

Fig A diagrammatic representation of organismic response

175. Define the following terms and give one example for each

(i) Commensalism

(ii) Parasitism

(iii) Comouflage

(iv) Mutualism

(v) Interspecific competition.

Ans : **OD 2011**

(i) **Commensalism :** It is an association between two species in which one lives attached to another but does not cause any harm. the host may actually derive some minor benefits. Examples are attachment of coelenterates to hermit crab, barnacles to the whales.

(ii) **Parasitism :** Parasitism is "a kind of relationship between two species in which one (the parasite not only derives its food from the other host) but spends a part of whole of its life on or in the body of other animal called the host." Ticks, mites and lice which live on the body of other animals are external parasites (ectoparasites). Malaria parasite, microfilarinae, tapeworm and roundworm are examples of internal parasites as they live inside the body of other animals (endoparasites). The dodder (Cuscuta), mistletoe (Loranthus, Viscum, etc.) and Rafflesia are parasitic plants.

(iii) **Camouflage :** It is a type of adaptations to conceal from a predator. They prey species have evolved some defence mechanisms e.g. some insects and frogs are cryptically coloured or camouflaged to avoid so that it may not be recognised by a predator.

Monarchfly is highly distasteful to its predator bird due to a chemical substance found in his body (butterfly acquires it in catepillar stage when feeding on poisonous weed). So they blend themselves according to their environment.

(iv) **Mutualism :** The most fascinating example of it is plant-pollinator interactions. IN mutualism (symbiosis) both the interacting species are benefitted mutually. Other examples are lichens, mycorrhizae, animal-plant relationships (show co-evolution). The fig is pollinated by female wasp Ophrys (orchid) uses sexual deceit for pollination by a pollinator bee.

(v) **Interspecific Competition :** This type of interaction occurs between the populations

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of two different species and such may be neutral, beneficial, detrimental etc. They may be mutualism, predation, parasitism, ammenaslism etc.

Population Interactions :

	Interaction	Species 'A'	Species 'B'
(i)	Ammensalism	−	0
(ii)	Commensalism	+	0
(iii)	Parasitism	+	−
(iv)	Predation	+	−
(v)	Competition	−	−
(vi)	Mutualism (Symbiosis)	+	+

[**Hint :** beneficial = +; detrimental = −; and neutral = 0 sign]

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176. With the help of suitable diagram describe the logistic population growth curve.

Ans : **OD 2019**

Logistic Curve :

(i) Full biotic potential of a species cannot be determined under natural conditions at all.

(ii) Increase in a population is not as rapid as it could if its growth was fully unimpeded.

(iii) When birth rate tends to remain above the death rate; the population will continue to grow and increase at an accelerating rate.

(iv) Consequently due to this increase, population will eventually produce conditions harmful to itself; the density and dependent factors will come into force them.

(v) The rate of growth will be then progressively curtailed until it reaches zero, where population reaches largest size.

(vi) If harmful effects of crowding increase proportionally; then the rate of change of population size can be represented by the equation as :

$$\frac{dN}{di} = \left(\frac{KN}{K}\right) N \log R$$

[Where $R =$ biotic potential per generation; $N =$ size of population at any moments; $K =$ maximum size for population in given area.]

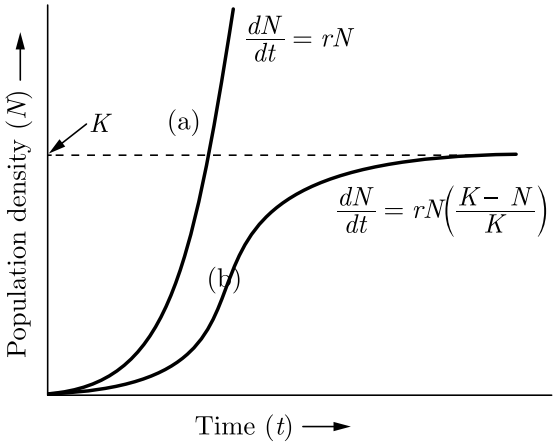

Fig Population Growth Curve : (a) when responses are not limiting the growth, plot is exponential, (b) when responses are limiting the growth, plot is logistic.

Note: K is carrying capacity.

The rate of increase of population is equal to the potential increase limited by the degree of realisation of maximal size. So growth of a self-limiting population is expressed graphically by S -shaped curve called logistic curve. This curve is a logarithmic in its beginning. Then it departs form the lograithmic increase as impending (interfering) factor becomes effective and reaches an inflection point (increase of growth becomes negative). Further, it approaches a point asymptote showing limiting size (K) of the population

[**Note :** Population of a wide variety of organisms ranging from unicellular bacteria to highly complex mammals (whales) follow logistic curve in their growth form.]

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177. What is population growth? Enlist the factors affecting it.

Ans : **FOREIGN 2018**

Population Growth : The individuals added to a population or lost from a population during a specific time determine the growth of population. It may be positive growth (number is added) or it may be negative (loss of individuals). When both are equal, it becomes stationary.

Factors : The size and density may be determined by the following factors.

(i) **Mortality :** It is the number of individuals removed/lost from a population per unit time. Increase in death rate decrease population size.

(ii) **Natality :** It is the number individuals added to a population. It increases population size.

190. Define population, explain in brief its various characteristics.

Ans : **OD 2010**

A population is a group of individual of the same species present in a particular area at a time. It is the aggregation of individuals that can interbreed. The population of an area does not remain constant due to variation in the number of individuals at different times. Plants, animals do form populations of different species in different areas.

Geographical isolated populations of the same species can inter breed. These are called as demes.

Characteristics of a Population : Following are the main characteristics of a population:

1. **Numerical Features are :**
   (a) Natality: i.e. birth rate of population.
   (b) Population density: Individual per unit area.
   (c) Mortality: i.e. death rate of population.
   (d) dispersal: i.e. movement of individuals.
2. **Structural Characters are :**
   (a) Age distribution.
   (b) Population growth pattern.
   (c) dispersion.

A population at any given time is composed of individuals of different ages. Age pyramid depicts the population structure.

Human males and females are shown in combined diagram. The shape of age pyramid depicts growth status of a population.

(a) growing or (b) stable of (c) declining.

Population size or population density is not measured in numbers only. Population growth in also effected by immigrations and emigrations both.

191. What are growth models, explain different types of such models.

Ans : **DELHI 2018**

Growth model is a predictable pattern of human population growth with time.

1. **Exponential Growth :** Growth of a population depends upon the availability of resources. When these are unlimited in the habitat, each species has the potential to grow in number. Then the population grows in an exponential or geometric fashion. In a population of size. N, birth rates are represented as b and death rates as d, then the increase or decrease in N during a unit time period t will be

$$\frac{dN}{dt} = (b - d) \times N$$

Let $(b - d) = r$

then $\frac{dN}{dt} = rN$

r is the intrinsic rate of natural increase. It is a very important parameter selected for assessing impacts of any biotic or abiotic factor on population growth.

The above equation explains the exponential geometric growth pattern of a population. It forms a J shaped curve when N is plotted in relation to time.

2. **Logistic Growth :** There is hardly any population with unlimited sources at its disposal to permit exponential growth. There is a competition for resources between the individuals of the populations. The survival of fittest acts in such conditions. In nature, a particular habitat has enough resource to support a maximum number of individuals. No further growth is possible beyond it. This limit is called carrying capacity (K) for that species in that habitat.

   Thus a population growing in a habitat with limited resources show.

   Alagphase initially, followed by acceleration and declaration and finally asymptote.

   A plot of N in relation to time (t) results in thus a sigmoid (S) curve. This type of growth is called logistic growth.

   Where $N =$ Population density at time t.

   $r =$ Intrinsic rate of natural increase

   $K =$ Carrying capacity.

   This type of growth model is considered more realistic.

CASE BASED QUESTIONS

192. Populations evolve to maximise their reproductive fitness in the habitat in which they live. Ecologists suggest, the life history of organisms have evolved in relations to the constraints imposed by the biotic and abiotic components of the habitat in which they live. This gets reflected in the population growth pattern of all organisms including humans.

Study the population growth curves shown in the given graph and answer the questions that follow :

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Fig Asparagus

(a) Euphorbia (b) Opuntia

(c) Acacia (d) Catotropis

Fig Xerophytic plants

(ii) **Adaptation in Saline Environments :** Halophytes grow in saline environment (either water or soil). Halophytes are found in tidal marshes and coastal dumes, mangrooves and saline soils. Mangrooves grow in tropical deltas along the ocena edges. They excrete salts by salt glands of their leaves Some exclude salts by roots into the soil. They have high levels of organic solutes (proline and sorbitol). Dunaliella is a green halophytic algae which occur in hyper-saline lakes. Mangrooves have pneumatophores (respiratory roots). Their seeds germinate on the trees.

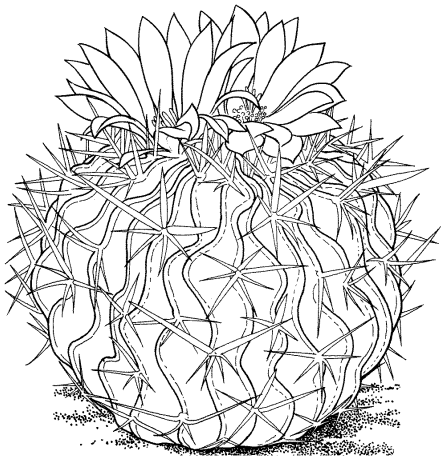

Fig Cacti (Opuntia)

180. What is adaptation? Classify plants on basis of environmental water.

Ans : **FOREIGN 2013**

Adaptation is the adjustment of the organisms according to its environment. All the plants fall into three groups on the basis of environmental water : (i) Hydrophytes, (ii) Xerophytes and (iii) Mesophytes.

(i) **Hyprophytes :** Plants growing in water are hydrophtes. They may be submerged e.g., Hydrilla, Ceratophyllum, Vallisneria etc. Some are floating e.g., Eicchornia, Jussiaea and Trapa etc. Somehave roots. IN some roots are totally absent. There may be waxy coating onleaves e.g., Nymphaea. The petiole in Eicchornia is swollen.

(ii) **Xerophytes :** They live in dry or xeric conditions and are of three types :

	Types of Xerophytes	**Examples**
(i)	Ephemerals	Drought escaping e.g., Argemone, Euphorbia.
(ii)	Succulents	Drought resisting e.g., Aloe, Cactus, Opuntia.
(iii)	True Xerophytes	Drought enduring e.g., Nerium.

Water is limited in deserts. The plants are adapted to xeric conditions. The distribution and productivity is based on the water deficiency there.

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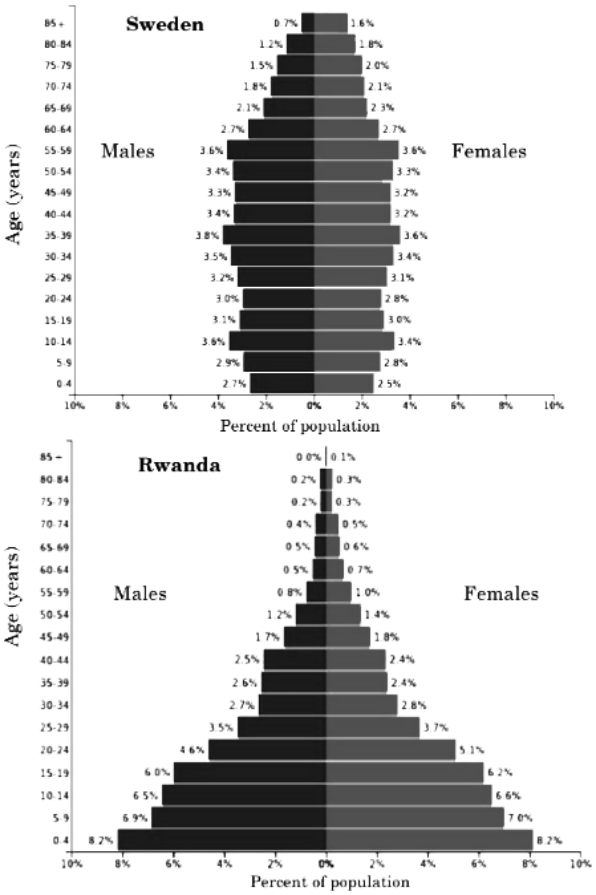


(i) What can be inferred from the very broad base of Rwanda's age pyramid ? Support your answer with the data provided in the figure.

(ii) Sweden has an age distribution that is approximately of the same width near its base as at the apex. What does this indicate ?

(iii) Name the type of age pyramid shown above for Sweden.

(iv) Name the type of age pyramid shown above for Rwanda.

Ans : **OD 2024**

(i) Rwanda – very broad base of Rwanda's age distribution indicates a rapidly growing population/population explosion/ Increasing population/ expanding population. - Because large number of individuals are in pre-reproduction age group.

(ii) It indicates that number of individuals in pre-reproductive and post-reproductive age groups are same.

(iii) Declining age pyramid.

(iv) Expanding age pyramid

195. In nature, the living organisms such as animals plants and microbes cannot live in isolation and therefore, interact in various way to form a biological community.

(i) What will happen if predators are absent ?

(ii) How does Monarch butterfly is highly distasteful to predators.

(iii) Majority of parasties harm the host. Give any two ways.

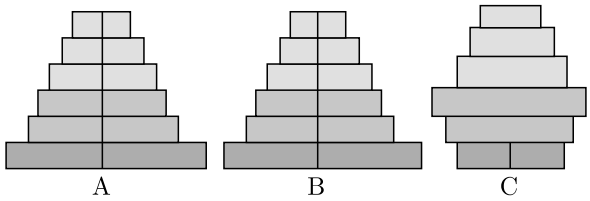
Ans : **SQP 2013**

(i) In the absence of predators, prey species could have very high population densities cause instability.

(ii) Because it secretes a special chemical present in its body. It acquire this chemical during the caterpillar stage.

(iii) (a) Reduces the ability of survival, growth and of reproduction.
(b) Reduces population density.

196. Study the tree different pyramis for human population given below and answer the following questions :



(i) Write the names given to each of these age pyramids.

(ii) Mention the one which is ideal for human population and why ?

(iii) What would be the growth rate pattern when the resources are unlimited ?

Ans : **FOREIGN 2008**

(i) A–Expanding pyramid
B–Stable pyramid
C–Dedining Pyramid

(ii) Stable pyramid is ideal for human population because it maintains the stability in all population phases.

(iii) Exponential

197. During a school trip to 'Rohtang Pass' one of your classmate suddenly developed 'altitude sickness'. But, she recovered after sometime.

(i) Mention one symptom to diagnose the sickness.

(ii) What caused the sickness?

(iii) How could she recover by herself after sometimes?

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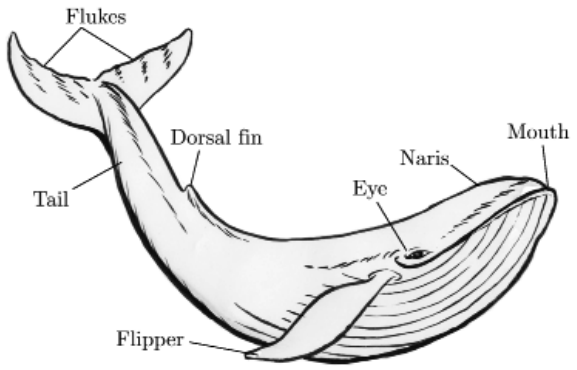

(c) The Whale, Placental Mammal

Fig Aquatic adaptations in animals

183. Explain the terms :

(i) Territory,

(ii) Population density,

(iii) Demography.

Ans : **DELHI 2016**

(i) **Territory :** It is defined as a space to live. Territory is a fundamental need of organisms. The space occupied by a breeding group or an individual is known as territory. The territory can not overlap e.g., the nest or burrow of an individual. In some animals its boundary is marked by defecation or urination in dogs.

(ii) **Population Density :** Population density is the number of individuals present in unit area at a given time. It is determined by all the individuals present and dividing it by the number of units of space.

(iii) **Demography :** Statistical study of human population is called demography.

184. Explain the following terms

(i) Age ratio

(ii) Sex ratio

Ans : **FOREIGN 2020**

(i) **Age ratio :** On the basis of reproductive ability of the individuals of a population, it can be divided into following age period.

(a) **Pre-reproductive :** On this age group individuals are not capable of reproduction. It is prior to reproductive period.

(b) **Reproductive :** It is a group in which the members are in a position to reproduce their own kind.

(c) **Post-reproductive :** In this group are the individual who have passed the reproductive phase.

(ii) **Sex Ratio :** It is ratio between males and females in a given population. If the number of males is more than the females then it is polyandrous and in other females may be more than the males, it is polygamous.

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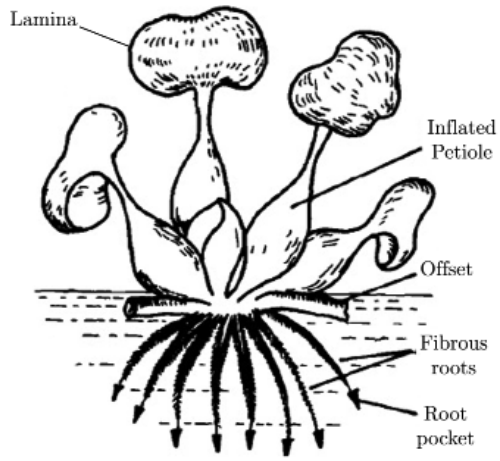
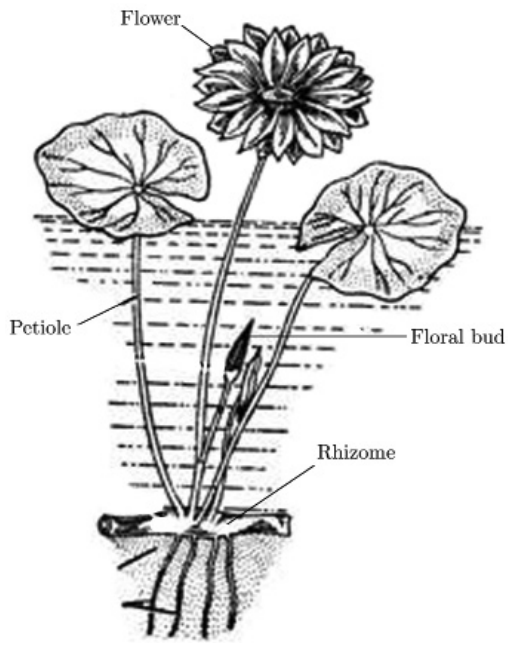
185. Draw figures of some hydrophtes.

Ans : **COMP 2017**



Eichhomia



Nymphaea

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(iii) **Mesophytes :** They grow in moderate amount of water e.g., crop plants, mango plants.

181. State the role of the following as vegetation

Ans : **DELHI 2014**

(i) **Atmospheric Humidity :** Water is present in the atmosphere as water vapours. The amount of moisture in air and vapours needed to saturate it is called relative humidity. When the atmosphere is warm, the humidity is less. The humidity is changed into dew when the atmosphere is cool. It is affected by temperature, pressure and soil water as well as vegetation of that area.

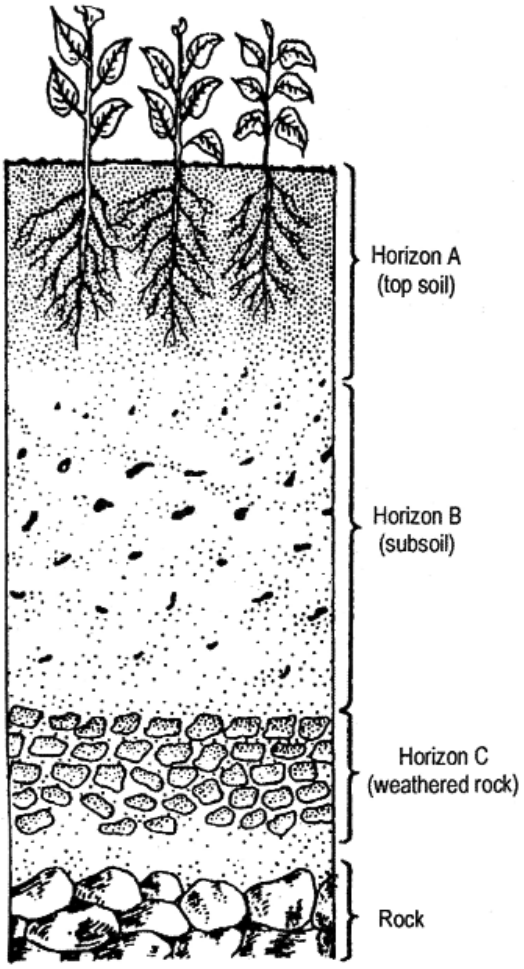


Fig Soil profile

(ii) **Edaphic Factors :** Soil may be alluvial, eolian, glacial and alluvial. The soil profile has 3 horizons-A, B and C. The soil consists of soil water, soil air, humus and mineral matter. Plants grow in soil. Loamy soil is best for growth of plants.

(iii) **Soil water :** There are different types of soil water-hygroscopic water capillary water. Gravitational water and chemical combines water. Plants use capillary water only.

182. Explain the response of all communities to environment over time.

Ans : **SQP 2008**

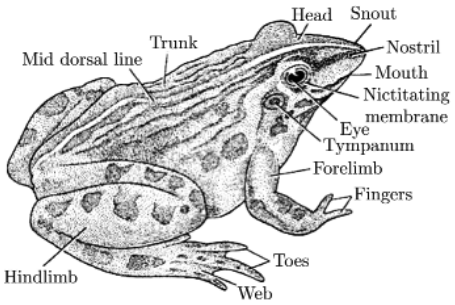
Response of all communities to environment over time : The abiotic conditions may show variation in several habitats. The organisms cope/manage with such drasting and stressful conditions. The organisms maintain it by homeostasis. The organisms overcome these by the following.

(i) **Regulate :** Regulation of body temeperature.

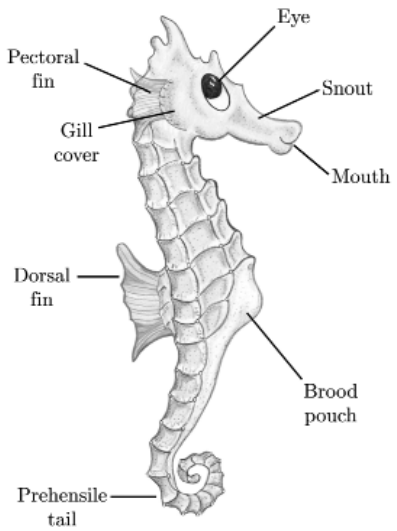
(ii) **Confirm :** Animals land plants may be conformers.

(iii) **Migrate :** Birds migrate to other places.

(iv) **Suspend :** Some animals like frog undergo aestivation and hibernation to avoid unfavourable circumstances.



(a) Rana Tigrina



(b) Sea Horse (male)

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188. Draw and describe (i) the expanding and (ii) Explain their long-term consequences on the human population.

Ans : **COMP 2015**

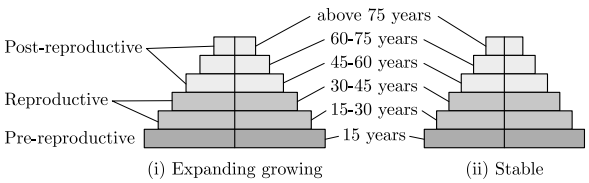
(i) **Age-pyramid :** The population at a time is composed of individuals of various ages; if the age distribution that is % individuals of a given age group is plotted for a population, resulting structure is known as the age-pyramid. The 3 types of age pyramids are following : (a) Growing/Expanding population, (b) Stable population and (c) Declining population/ decreasing age profile.

(a) **Expanding Age pyramid :** This pyramid shows more pre-reproductive and reproductive individuals than post reproductive age ration.

(b) **Stable age profile is ideal for a population :** Since it shows moderate ratio of pre-reproductive and post reproductive i.e., young to old. The rate of growth is slow and stable. Pre-reproductive and reproductive age groups are more or less equal in population size. The post reproductive group is smallest.

1. **Pre-Reproductive :** The individuals are not capable or reproduction. It is prior to reproductive period.
2. **Reproductive :** The members are in a position to reproduce their own kind.
3. **Post-reproductive :** The individuals who have passed the reproductive phase.

(ii) Due to expanding of human population there is population explosion and that depends on natality, mortality, emigration and immigration.



189. What do you mean by adaptation? Describe adaptations of aquatic organisms (for both plants and animals).

Ans : **OD 2011**

The term adaptation means adjustment or changes in behaviour, physiology and structure of an organism to become more suited or fit to an environment. This helps an organism to become better fitted to survive and passing their genes on to the next generation.

Adaptations in Aquatic Plants : Following types of adaptations are found in aquatic plants.

1. Air-cavities are present, due to which plants are able to float on the water.
2. Cuticle is not present on the epidermis, but mucous layer is present on the epidermis of floating plants, i.e. Pistia. Stomata are not present in submerged plants.
3. Their roots are poorly developed, because entire part of the plant absorbs water. Sometimes roots are absent like Wolffia, Ceratophyllum.
4. Leaves of submerged plants are thin and ribbon-shaped, e.g. Vallisneria and these are large, flat and complete in floating plants. Petiole is swollen in Trapa and Eichhornia.
5. Stems are long, thin, soft and spongy in submerged plants. Stem floats horizontally in free-floating plants, e.g. Azolla, Eichhornia. Pistia has stolon.
6. Stem of rooted hydrophytes spreads on the bottom to form rhizome and remains fixed in the mud, e.g. Pistia and Nelumbium.
7. Hypodermis is absent in the stems of submerged plants, e.g. in Hydrilla and Potamogeton mechanical tissues are not present. But cortex is developed.

Adaptations in Aquatic Animals : Following types of adaptations are found in aquatic animals.

1. Body is streamlined in shape which helps to minimize water resistance.
2. Locomotory organs are developed as the fins to swim in water easily.
3. Some aquatic forms like amphibians have a thin fold of skin in between the digits of the hind limbs, called as web. It helps to increase the surface area for swimming.
4. Respiratory organs are the gills in complete aquatic forms likes fishes while other also contain nostrils located near top of head to enable them to inhale over water surface e.g. crocodiles, frogs etc.
5. Their body is covered with scales have thin layer of mucus which the body slippery that help them to escape from enemies. Along with it, it also protect their skin from water.
6. Some fishes possess hydrostatic organ called air bladder, which helps them in adjusting in different depths of water according to their need by increasing or decreasing the amount of air in it.

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(iii) **Emigration :** It is the number of individuals going out and joining other population.

(iv) **Immigration :** The number of individuals being added to a population and increase population density them.

(v) **Environment Factors :** Food, shelter, flood, earthquake, storms, heat, cold, draught etc. may decrease population. The resources food and unlimited are may increase the size of a population the population grows by geometric ratio (Malthus view).

178. What are different types of adaptations in animals? Explain with suitable examples.

Ans : **COMP 2017**

Adaptations in Animals : Adaptation is "the adjustment of the organisms according to their environment." They show many morphological, anatomical and physiological adaptations. Adaptation evolve after a long period of time.

The carnivores and herbivores possess adaptation to eat same kind of food. Some animals have adaptation to protect themselves from the others. Some show behavioural adaptation to mate e.g. birds. Some animals migrate to other places. Some animals show aestivation, hibernation (e.g. frog), camouflage, mimicry and echolocation etc.

	Types of Migration	**Examples**	**Activities of Animals**
(i)	Long Distance Migration	Arctic tern (sea bird)	The nests are located close to north pole in summer. It flies south to Antarctica in autumn season. It returns to north pole again in each spring.
(ii)	Short-Distance Migration	Some birds	The birds migrate by using sun, moon, starts or magnetic field for direction and navigation etc.
		Elk, Caribou and Whale	They migrate in search of food each winter to warmer places.
(iii)	Periodic Migration	Locust shows migration for food.	The large populations of locust migrate in search of feeding grounds to distant places.

179. How do plants adapt to (i) water scarcity and (ii) saline environments?

Ans : **OD 2016**

(i) **Adaptation to Water Scarcity :** The plants in deserts adapt to survive in xeric conditions of soil and high temperature.

	Type of Xerophyte(s)	**Characteristics along with Example (s)**
(i)	Ephemerals	Draught escaping. e.g. Argemone. The evade dry conditions. The plants complete their life cycle quickly.
(ii)	Succulents	Draught resisting. e.g. Aloe, Agave, Cacti. To store water in stem is called succulence. Leaves are reduced to spines Stem is spongy and fleshy. They have CAM pathway of photosynthesis.
(iii)	True Xerophytes	Draught enduring. e.g. Nerium, Acacia, Ziziphus, Calotropis, Tamarix. Some xerophytes accumulate proline in their cells. Chaperonins are heat shock proteins.

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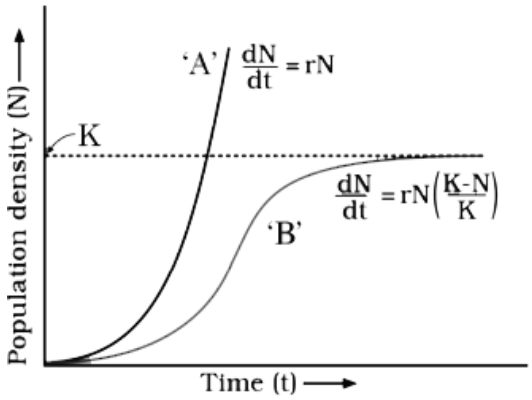

(i) Identify the growth curves 'A' and 'B'.
(ii) Mention what does the dotted line in the graph indicate and state its importance also.
(iii) Growth curve 'B' shows a different pattern from that of growth curve 'A'. Justify giving one reason.
(iv) (a) Which one of the two curves is more "realistic" and why ?
(b) Which one of the two curves is relevant in present days with respect to human population in our country and why ?

Ans : **OD 2024**

(i) (a) A- exponential growth curve/ J-shaped curve
(b) B- Logistic growth curve/ S- shaped curve/ sigmoid curve
(ii) (a) It represents carrying capacity (K)
(b) Maximum possible number of individuals beyond which no growth of population is observed.
(iii) Growth curve B is formed when resources (food and space) in nature are limited have environmental checks while growth curve A is formed when resources are unlimited with no environmental checks.
(iv) (a) (i) 'B'/ Logistic growth curve
(ii) As resources are never infinite in nature.
(b) (i) J-shaped curve/ exponential growth
(ii) It is a continuous growing population.

193. Generally, in eukaryotic cells the average length of a transcription unit along a DNA molecule is about 8,000 nucleotides, so the RNA product of the transcription is also that long. But it only takes about 1200 nucleotides from the above RNA product to translate average sized polypeptide of 400 Amino acids.

(i) Name this RNA product transcribed from the DNA that subsequently translates into a polypeptide of 400 amino acids. Mention the enzyme responsible for transcribing this type of RNA from the DNA.
(ii) Name and explain the process the RNA molecule transcribed from 8000 nucleotide long DNA undergoes to be able to translate a polypeptide of 400 amino acids.
(iii) Write the number of RNA polymerases involved in the transcription of DNA in a prokaryote and eukaryotes.
(iv) Mention the difference in the site of transcription in a prokaryote and eukaryote cell.

Ans : **OD 2024**

(i) (a) hnRNA/ heterogeneous nuclear RNA
(b) RNA polymerase II
(ii) hnRNA undergo capping at 5' end (methyl guanosine triphosphate/mGppp), and tailing at 3' end (with poly A tail or adenylate residue), further splicing is carried out, where non coding sequences or introns are removed and coding sequence or exons are joined together/ diagrammatic representation with given markers can also be considered.
(iii) (a) In prokaryotes - 1
(b) In eukaryotes-3
(iv) In prokaryotes the transcription takes place in the cytoplasm/cytosol whereas in Eukaryote transcription occurs in the Nucleus

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194. Study the figures given below that depict the comparative age distribution of human populations in Sweden and Rwanda. (International Data Base 2003) and answer the questions that follow :

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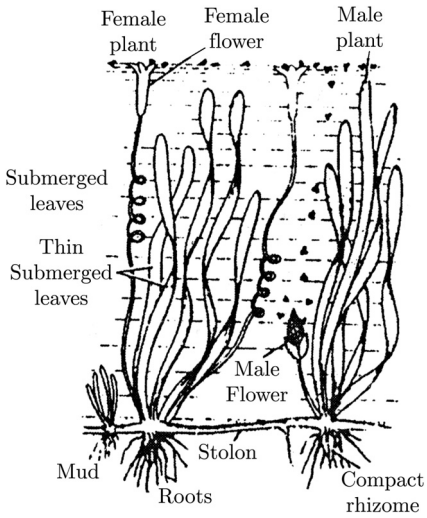


Fig Some hydrophytes

186. What is competition? Write a brief note on competition among organisms.

Ans : **OD 2009**

Competition is a key phenomenon for the survival of a species. It can be defined as "rivalry between two or more organisms requiring the same resources or things". Among the animals, the individiuals of the same species have to often compete for food, rank, territory and mates. e.g., sparrows fighting with one other for shelter, house lizards chasing each other to catch food (insects). The plants also show competition for space, water and minerals. Seeds falling very close to each other from the parent plant to give rise to a dense mass of seedling which compete among themselves for their own requirements. Some grow faster than the others and survive; others remain weak and may eventually die. Competition is reduced by various mechanisms of seed dispersal. IN some desert plants roots secret certain compoudns that inhibit the terminations of other seeds within a certain distance. Intra-specific competition generally heps to maintain a balance between the available resources and the number of individuals in a species.

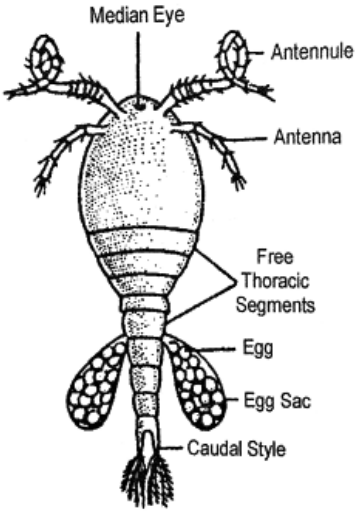
As a result of many interactions, (competitions) that occur within the members of same species and other species only the most fittest survive as a result of struggle for existence according to Darwin.

There may be competitive release e.g. Balanus on rocky sea coast of Scotland (Cannell's elegant field experiments). Resource partitioning occurs. McArther explain "that is closely related species of warblers live in same tree avoided competition due to their different behavioural differences."

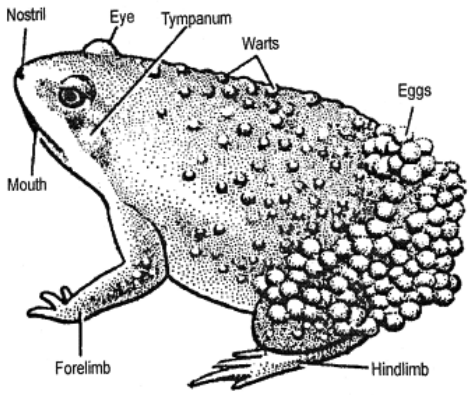
187. What do you understand by (i) Cooperative and (ii) Competitive interactions, among the members of a species?

Ans : **SQP 2016**

Individuals of species interact with each other in different ways may be categorized as cooperative and competitive. Cooperative interaction is essential for reproduction and perpetuation of the species race. In plants where such interaction is not apparent, it does exist, for example cross fertilized plants. In animals it is easier to observe cooperative and competitive intra-specific interactions. There are many aspects of animal behaviour that involves primary interactions between members of the same species. Cooperation of asexual reproduction and rearing of the young are the most fundamental and universal interactions found in animals.



(a)



(b)

Fig (a) Cyclops, (b) Alytes (carring eggs)

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Ans : **COMP 2020**

(i) The symptoms are :
  (a) nausea
  (b) fatigue
  (c) heart palpitations

(ii) It is because at high altitudes, the atmospheric pressure is low and the body does not get enough oxygen.

(iii) She would recover after sometime as the body would get acclimatised by
  (a) Increasing the breathing rate
  (b) Increasing the production of red blood cells
  (c) Decreasing the binding capacity of haemoglobin.

NODIA

22. The second stage of hydrosere is occupied by plants like
(a) Azolla (b) Typha
(c) Salix (d) Vallisneria

Ans : SQP 2013

Vallisneria is at second stage of hydrosere. It starts orginating in a pond with colonisation of some phytoplanktons which forms the pioneer plant community. The stages are
1. Bacteria, blue-green algae and algae
2. Hydrilla, Potamogeton and Vallisneria
3. Nelumbo, Nymphaea, Trapa, Azolla and Wolffia
4. Typha and Sagitaria
5. Juncus and Cyperus
6. Salix and Populus, Almus.

Thus (d) is correct option.

23. Identify the possible link 'A' in the following food chain
Plant → Insect → Frog → 'A' → Eagle
(a) Rabbit (b) Wolf
(c) Cobra (d) Parrot

Ans : SQP 2018

The given food chain should be
Plant → Insect → Frog → Cobra → Eagle
Thus (c) is correct option.

24. Which one of the following statements is correct for secondary succession?
(a) It occurs on a deforested site.
(b) It follows primary succession.
(c) It is similar to primary succession except that it has a relatively fast pace.
(d) It begins on a bare rock.

Ans : FOREIGN 2017

Secondary succession of subsere is ecological succession that takes place in a recently denuded area which still contains a lot of organic debris, remains and propagules of previous living organisms. It is more common and caused by baring of an area due to the forest fires, deforestation, excessive overgrazing, landslides, earthquakes, repeated floods, etc.
Thus (a) is correct option.

25. Which one of the following statements for pyramid of energy is incorrect whereas the remaining three are correct?
(a) It show energy content of different trophic level of organisms.
(b) It is inverted in shape.
(c) It is upright in shape.
(d) Its base is broad.

Ans : OD 2015

Pyramid of energy is graphic representation of energy per unit area sequence-wise in various rising trophic levels with producers at the base and top carnivores at the apex. Pyramid of energy is upright in all cases. It is also more accurate than other types of ecological pyramids.
Thus (b) is correct option.

26. Mass of living matter at a trophic level in an area at any time is called.
(a) standing crop (b) detritus
(c) humus (d) standing state

Ans : COMP 2015

Standing crop is the total amount of living matter in a specified population at a particular time, expressed as biomass (standing biomass) or its equivalent in terms of energy. The standing crop may vary at different times of the year for example in a population of deciduous trees between summer and winter.
Thus (a) is correct option.

27. Of the total incident solar radiation the proportion of PAR is
(a) about 70% (b) about 60%
(c) less than 50% (d) more than 80%

Ans : COMP 2012

The source of energy in all ecosystem is solar energy. About 50% of the solar energy incident over earth is present in PAR (Photosynthetically active Radiation). About 1-5% of incident solar radiation or 2-10% of PAR is captured by the photosynthetic organisms in the synthesis of organic matter (gross primary productivity).
Roughly 20% of it is consumed in respiration so that net capture of energy (net primary productivity) is 0.8-4% of incident radiation of 1.6-8% of PAR.
Thus (c) is correct option.

28. The biomass available for consumption by the herbivores and the decomposers is called
(a) net primary productivity
(b) secondary productivity
(c) standing crop
(d) gross primary productivity

Ans : DELHI 2019

Net primary productivity is equal to the rate of organic matter created by photosynthesis minus the rate of respiration and other losses. It is

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relationship forming a **food chain**.

Chemical Energy in the living world is transferred through the food chain. In nature simple food chains do not exist. The food relationship are very complex forming a kind of food web.

The examples of food chains are following :

1. **GFC (grazing food chain) :**

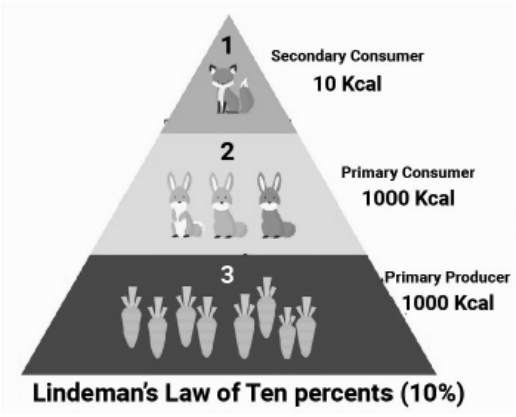
Grass (Producer) ⟶ Goat (Primary consumer or Herbivore) ⟶ Human beings (Secondary consumer or carnivore)

2. **DFC (detritus food chain) :**

Saprotrophs ⟶ Detritus consumers (microbes) ⟶ Gamefish (consumer)

7.2 Transfer of Energy

It follows 10 percent (lindeman law) law.



7.3 Ecological Pyramid

In a **food chain** the numbers at the successive higher level get gradually smaller, forming a kind of food pyramid. There are three ecological pyramids :

1. **pyramid of biomass**,
2. **pyramid of energy** and
3. **pyramid of number**.

The **base** of a pyramid is **broad**. It **narrows** towards the apex.

8. TROPHIC LEVEL

The trophic level is the position that an organism occupies in a food chain.

9. NUTRIENT CYCLING

It includes "the storage and transfer of nutrients through various components." Therefore, the storage and movement of nutrient elements through the different components of the ecosystem is termed as the **nutrient cycling**.

Two kinds of cycling are (i) **gaseous** and (ii) **sedimentary**. Ecosystem cycles has 3 aspects (i) input, (ii) output, (iii) internal cycling of nutrients.

They are called **biogeochemical cycles.** The gaseous cycles are "nitrogen cycle, oxygen cycle, hydrogen and carbon cycles." The sedimentary cycles are "sulphur, phosphorus and Calcium cycles."

10. STANDING SATE

Standing sate is "the amount of nutrients present in soil at a given time".

11. ECOLOGICAL SUCCESSION: IT IS KNOWN AS BIOTIC SUCCESSION

1. Ecological succession is called "biotic succession." It refers to "a natural development of a series of biotic communities at the same place one after the other till the climax community is developed there."

   Biotic communities are not static. Changes in a community are the **primary** and **secondary successions**. During succession one community is replaced by another community.

2. **E.L. Brun** observed biotic succession in vegetation. "Plant succession is an ordely process of community change in an unit areas." **(E.P. Odum)**.

   Biotic succession brings about progressive drastic changes in habitats. They may be **extreme** to optimum for the plants. The **life forms** are changed during **biotic succession**. Biotic, topographic and climatic factors may cause succession. Succession starts in different environmental conditions upto climax. Sometimes the actual climax may be destroyed by grazing, fire, cutting etc. The climax may be replaced due to some factors. The modified climax is called **disclimax**.

3. Succession may be **primary** or **secondary**. Succession may be of following types: **mesosere, halosere, xerosere (on track or sand), hydrosere (in pond or lake), lithosere (on rocks) and serlue** (miniature biotic succession of microbes).

   Some areas are destroyed or modified by man by his own activities. The secondary succession starts on these areas with grasses and herbs. There are pioneer communities

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9. A river with an inflow of domestic sewage rich in organic waste may result in
(a) increased population of aquatic food web organisms
(b) an increased production of fish due to biodegradable nutrients
(c) death of fish due to lack of oxygen
(d) drying of the river very soon due to algal bloom

Ans : **SQP 2017**

A river with an inflow of domestic sewage rich in organic waste will reduce the dissolved oxygen (DO). The organic waste will increase biological oxygen demand of the river thus depleting the O_2 content and may result in death of fish due to lack of oxygen.
Thus (c) is correct option.

10. Which is the National Aquatic Animal of India?
(a) River dolphin (b) Blue whale
(c) Seahorse (d) Gangetic shark

Ans : **FOREIGN 2020**

River dolphin is the National Aquatic Animal of India. This mammal exclusively reside in freshwater or brackish water.
Thus (a) is correct option.

11. Which one of the following is a characteristic feature of cropland ecosystem?
(a) Least genetic diversity
(b) The absence of weeds
(c) Ecological succession
(d) The absence of soil organisms

Ans : **COMP 2015**

Cropland ecosystem is largest anthropogenic ecosystem characterised by less diversity and high productivity.
Thus (a) is correct option.

12. The primary producers of the deep-sea hydrothermal vent ecosystem are
(a) green algae
(b) chemosynthetic bacteria
(c) blue-green algae
(d) coral reefs

Ans : **OD 2018**

The primary producers of the deep-sea hydrothermal vent ecosystem are archaebacteria. There have chemosynthetic mode of nutrition. Thus option (b), i.e., chemosynthetic bacteria is the correct option.
Thus (b) is correct option.

13. In which of the following both pairs have correct combination?

(a)	Gaseous nutrient cycle	Carbon and nitrogen
	Sedimentary nutrient cycle	Sulphur and phosphorus
(b)	Gaseous nutrient cycle	Carbon and sulphur
	Sedimentary nutrient cycle	Nitrogen and phosphorus
(c)	Gaseous nutrient cycle	Nitrogen and sulphur
	Sedimentary nutrient cycle	Carbon and phosphorus
(d)	Gaseous nutrient cycle	Sulphur and phosphorus
	Sedimentary nutrient cycle	Carbon and nitrogen

Ans : **DELHI 2006**

Gaseous nutrient cycle	Carbon and nitrogen
Sedimentary nutrient cycle	Sulphur and phosphorus

The biogeochemical cycles are of two types, i.e. gaseous cycles, in which the reservoir for the nutrient elements is in the atmosphere (air) or hydrosphere (water). The four most abundant elements in the living systems, i.e. hydrogen, carbon, oxygen and nitrogen have predominantly gaseous cycles.
In sedimentary cycles, the reservoir for the nutrient elements is in the sediments of the earth. Elements, such as phosphorus, sulphur, potassium and calcium have sedimentary cycles.
Thus (a) is correct option.

14. During ecological succession
(a) the gradual and predictable change in species composition occurs in a given area
(b) the establishment of a new biotic community is very fast in its primary phase.
(c) the numbers and types of animals remain constant
(d) the changes lead to a community that is in near equilibrium with the environment and is called pioneer community

Ans : **SQP 2020**

The gradual and fairly predictable change in the species composition of a given area is called ecological succession. During succession some

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ponds of fresh water are lentic ecosystems. Rivers and streams are **lotic** ecosystems. The physical conditions of lakes and ponds depend upon the size and depth, latitude, altiude and the surrounding biome.

OBJECTIVE QUESTIONS

1. Which one is hydrophytic plant
(a) Trapa (b) Opuntia
(c) Dulbergia (d) Acacia

Ans : **OD 2024, 2017**
Out of the given option trapa is a hydrophytic plant, while others are xerophytic plants.
Thus (a) is correct option.

2. Flow of energy in food chain of an Ecosystem is:
(a) Unidirectional (b) Bidirectional
(c) Multi-directional (d) None

Ans : **OD 2017**
Flow of energy in food chain in ecosystem is always unidirectional. In it, energy is passed from one level to another unidirectionally.
Thus (a) is correct option.

3. The term 'Ecosystem' was proposed by:
(a) Gardener (b) Odum
(c) Tansley (d) Warming

Ans : **OD 2013**
The term ecosystem was first proposed by Arthur Tansley.
Thus (c) is correct option.

4. Secondary productivity is related to:
(a) Producers (b) Herbivores
(c) Carnivores (d) None of these

Ans : **OD 2013**
Secondary productivity is the rate of biomass formation or energy fixation by heterophic organisms, such as grazers and decomposers. These derive all their energy from photosynthetic plants and other autotrophs, either directly or indirectly and their productivity determines the number of trophic levels and the lengths of the food chains within an ecosystem-both of which are likely to be increased by greater secondary productivity.
Thus (b) is correct option.

5. Green plants in an ecosystem are:
(a) producers (b) consumers
(c) decomposer (d) none of these

Ans : **OD 2011**
Green plants in an ecosystem are regarded as producers as they are autotrophic i.e. Synthesize their own fool by the process of photosynthesis. Consumers and decomposers are heterotrophic organisms.
Thus (a) is correct option.

6. Which one of the following is the correct food chain?
(a) Grass, Wheat and Mango
(b) Grass, Goat and Lion
(c) Goat, Cow and Grass
(d) Grass Fish and Goat

Ans : **OD 2011**
Grass, Goat and Lion correct food chain. In it, grass is producer, goat is primary consumer and lion is secondary consumer. Grass → Goat → Lion.
Thus (b) is correct option.

7. Which ecosystem has the maximum biomass?
(a) Forest ecosystem
(b) Grassland ecosystem
(c) Pond ecosystem
(d) Lake ecosystem

Ans : **COMP 2015**
Biomass refers to the amount of living organic matter. Forest ecosystem have the maximum biomass, because it includes organisms of all trophic levels as compared to pond, lake or grassland ecosystem. In forest ecosystems productivity is also high that contributes to maximum biomass.
Thus (a) is correct option.

8. Presence of plants arranged into well defined vertical layers depending on their height can best seen best in
(a) tropical savannah
(b) tropical rain forest
(c) grassland
(d) temperate forest

Ans : **DELHI 2016**
Tropical rain forests show stratification. It can be defined as the grouping of plants into two or more well defined layers depending upon their height. These layers as called strata or storeys. There storeys consist of respectively very tall emergent trees, tall trees, small trees, a shrub layer and a ground layer of ferns mosses and herbs.
Thus (b) is correct option.

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34. The slow rate of decomposition of fallen logs in nature is due to the
(a) low moisture content
(b) poor nitrogen content
(c) anaerobic environment around them
(d) low cellulose content

Ans : FOREIGN 2015

The slow rate of decomposition of fallen logs in nature is due to their low moisture content.
The cellulose is in high amount in fallen logs.
The environment arround the fallen logs is aerobic, i.e. O_2 is present.
Thus (a) is correct option.

35. A lake near is village suffered heavy mortality of fishes within a few days. Consider the following reasons for this
I. Lots of urea and phosphate fertiliser were used in the crope in the vicinity.
II. The area was sprayed with DDT by an aircraft.
III. The lake water turned green and stinky.
IV. Phytoplankton populations in the lake declined initially thereby greatly reducing photosynthesis.
Which two of the above were the main causes of fish mortality in the lake?
(a) II and III (b) III and IV
(c) I and III (d) I and II

Ans : COMP 2008

A lake near a village suffered heavy mortality of fishes within a few days. Because lots of urea and phosphate fertiliser were used in the crops in the vicinity and the area was sprayed with DDT by an aircraft.
Inorganic phosphorus and nitrogen are responsible for the growth of algae. In polluted water these increase due to which algae increase greatly at the surface of water forming water bloom. Due to death of these algae their organic matter gets decomposed due to which oxygen gets depleted and aquatic animal dies.
Thus (d) is correct option.

36. Which of the following ecosystem types has the highest annual net primary productivity?
(a) Tropical rain forest
(b) Tropical deciduous forest
(c) Temperate evergreen forest
(d) Temperate deciduous forest

Ans : DELHI 2020

Productivity of tropical rain forest is highest. The tropical rain forest cover 300000 km^2 area. They contain more than 50% of total flora and fauna of the world.
Thus (a) is correct option.

37. Which one of the following is not used for constructing of ecological pyramids?
(a) Dry weight
(b) Number of individuals
(c) Rate of energy flow
(d) Fresh weight

Ans : SQP 2009

Ecological pyramids are the graphical representation of the trophic structure and function at successive trophic levels. Ecological pyramids are of three general types, listed as here under:
1. **Pyramid of Numbers**, showing the number of organisms at each matter.
2. **Pyramid of Biomass**, showing the total dry weight of living matter.
3. **Pyramid of Energy**, showing the rate of energy flow/productivity at successive trophic levels.

Thus, fresh weight is not used for the construction of ecological pyramids.
Thus (d) is correct option.

38. Prolonged liberal irrigation of agricultural fields is likely to create the problem of
(a) acidity (b) aridity
(c) mental toxicity (d) salinity

Ans : OD 2024, 2005

Prolonged liberal irrigation of agricultural fields create the problem of salinity. Since, all surface ground water contains salts to varying degrees, irrigation is the primary cause which brings salinity to the field.
Thus (d) is correct option.

39. More than 70% of world's fresh water is contained in
(a) Antarctic
(b) glaciers and mountains
(c) greenland
(d) polar ice

Ans : SQP 2013

More than 70% of word's fresh water is contained in Polar ice. Three-fourth surface of earth is occupied by oceans which contain 97.5% of total water. This is marine water with about 3.5% salt contents. Rest water, i.e. 2.5% is fresh water which occurs on land. Most amount of this water (about

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species colonise an area and their populations become more numerous, whereas populations of other species decline and even disappear.
Thus (a) is correct option.

15. Most animals that in deep oceanic water are
(a) primary consumers
(b) secondary consumers
(c) tertiary consumers
(d) detritivores

Ans : FREIGN 2020

Most animals that live in deep oceanic waters and called benthos are scavengers or detritivores. These organisms include crustaceans, polychaetes and some microorganisms.
Thus (d) is correct option.

16. If 20 J of energy is trapped at producer level, then how much energy will be available to peacock as food in the following chain?
Plant → Mice → Snake → Peacock
(a) 0.02 J (b) 0.002 J
(c) 0.2 J (d) 0.0002 J

Ans : SQP 2013

According to 10% law of energy flow by Raynold Lindeman. The total amount of energy that can be transferred to the next trophic level is the 10% hence, peacock will receive 0.02 J of energy as top consumer.
Energy received by other organisms are

$$\text{Plant} \rightarrow 20\,\text{J}$$

$$\text{Mice} \rightarrow 20 \times 10\% = 2\,\text{J}$$

$$\text{Snake} \rightarrow 2 \times 10\% = 0.2\,\text{J}$$

Thus (c) is correct option.

17. Natural reservoir of phosphorus is
(a) rock (b) fossils
(c) sea water (d) animal bones

Ans : FOREIGN 2011

The natural reservoir of phosphorus is in phosphate rocks. Phosphate is added in small amount into the cycling pool through weathering of rocks. Phosphate circulate in the abiotic environment in lithosphere as well as hydrosphere.
Thus (a) is correct option.

18. Secondary productivity is rate of formation of new organic matter by
(a) producer (b) parasite
(c) consumer (d) decomposer

Ans : COMP 2007

Secondary productivity is the rate of formation of new organic matter by consumers. Primary productivity depends on the producers inhabiting a particular area. Decomposers breakdown complex organic matter into inorganic substances like carbon dioxide, water and nutrients. Parasitic species feed on the body of other organism.
Thus (c) is correct option.

19. Which one of the following is not a gaseous biogeochemical cycle in ecosystem?
(a) Sulphur cycle
(b) Phosphorus cycle
(c) Nitrogen cycle
(d) Carbon cycle

Ans : DELHI 2007

Phosphorus cycle is a sedimentary biogeochemical cycle. It describes the movement of phosphorus through the lithosphere, hydrosphere and biosphere and the main reservoir pool is lithosphere.
Atmosphere does not play any significant role in the movement of phosphorus because phosphorus and phosphorus based compounds are usually solids at the typical ranges of temperature and pressure found on earth. The production of phosphine gas occurs only in specialised, local conditions.
Thus (b) is correct option.

20. Which one of the following is not a functional unit of an ecosystem?
(a) Energy flow (b) Decomposition
(c) Productivity (d) Stratification

Ans : OD 2010

Stratification is not the functional unit of ecosystem. Vertical distribution of different species occupying different levels is called stratification. It represent the structural unit of an ecosystem. For example, trees occupy top vertical strata or layer of a forest, shrubs the second and herbs and grasses occupy the bottom layers.
Thus (d) is correct option.

21. The upright pyramid of number is absent in
(a) pond (b) forest
(c) lake (d) grassland

Ans : DELHI 2019

Pyramid of number represents the number of individuals per unit area at various trophic levels. It is always upright in grassland, pond and lake ecosystems. But in forest or single tree ecosystem, it is spindle-shaped and of parasitic food chain is considered then it will be an inverted pyramid.
Thus (b) is correct option.

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too. They are then replaced by shrubs and trees. The climax stage is woodland stage.

4. **Ecosystem Development** is called **ecological succession. Monoclimax theory** pleads for only one climax which is determined by the climate of the area.

   Polyclimax theory was proposed by **A.G. Tansley** and it holds that climax is determined by many factors.

5. **Sere :** The whole series of communities (plant and animal life) which develop in a given area is called a sere. e.g., Serial communities in rooted submerged stage are Vallisneria and Potamogeton. **Climatic climax** is "the maximum temperature at which a community survives." It is the last stage of succession in a locality.

(a) **Secondary Succession :** It occurs when an early community gets damaged due to pets, fire, floods, leaving only a few species to survive.

It due course of time, new species get established and the secondary succession ends.

Secondary succession is also called **subsere**. Examples of secondary succession are **grasslands** and **forests**.

12. PLANT SUCCESSION

The biotic community is **dynamic** and undergoes changes with the passage of time. These changes are sequentially ordered and constitute succession.

Succession involves "replacement of one community by the other". Succession begins with invasion of the **barren area** by the **pioneer species**, which later, make way for other species. Ultimately, succession leads to a **climax community**.

The climax community remains **stable** as long as environment remains unchanged.

Communities between pioneer and climax stages are called **seral**. Succession on sand is called **psammosere**. Succession in water is **hydrosere**. Succession in dry places/deserts is called **xerosere**. Succession on **sand dunes** is **primary succession**. The last established community of plant succession is called **climax community**.
Succession in water is **hydrosere.** Succession in dry places/deserts is called **xerosere**.

13. ECOSYSTEM SERVICES

The various products of ecosystem processes are called ecosystem services. The examples are purification of air, purification of the water by forests.

14. BIOMES OF THE WORLD

The **major biomes** are: (i) Tundra, (ii) Northern conifer forest, (iii) Deciduous forest, (iv) Tropical rain forest, (v) Chaparral, (vi) Tropical Savannah, (vii) Grassland, (viii) Desert.

(a) **Tundra Biomes** is located in Europe, North America, Asia about 60° N latitude. Trees are absent in this area.

(b) **Taiga** includes north coniferous forest of North America, Europe and Asia. The rainfall is 10-30 cm.

(c) **Deciduous Forests** are found in temperate region of North Central Europe, Eastern Asia and Eastern United States.

(d) **Tropical Rain Forests** are located in equatorial regions where the annual rainfall exceeds 140 cm in Central America, South America etc. They are dominated by the trees.

(e) Chaparral biome is called mediterranian scrub forest. Characterised by very limiting winter rain.

(f) **Tropical Savannah** are tropical grassland and are dominated by herbaceous species. They are meadow like and treeless found in South America, Africa and Australia where the average rainfall is 100-150 cm.

(g) **The Temperature Grasslands** are found in the Prairies of Canada and U.S.A., Pampas in South America and Steppes in Europe and America and velds in Africa. The annual rainfall is from 25-75 cm.

(h) **Desert Biomes** are found is South Western Mexico, Coastal aera of Chille and Peru, Sahara desert of North Africa and Gobi. They have low **herb** and **shrub** covers with bare ground, Thar desert of Asia etc. Their climate is very hot and dry with low rain fall and high evaporation rate. The animals found there are called **desert animals**.

15. MARINE ECOSYSTEM

The main characteristics of **marine environment** is high **salinity**. The **deep waters** of the **ocean** basin are vertically divided into an upper layer of **euphotic zone** followed by **less lighted euphotic** zone and their **dark abyssal zone**. The three major environments are-(i) **littoral**, (ii) **benthonic** and (iii) **pelagic**. Marine-life can be classified into-(i) Phytoplankton and (ii) Zooplankton.

16. FRESH WATER ECOSYSTEMS

They are lentic and lotic system. Lakes and

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the biomass available for consumption by the herbivores and the decomposers.
Thus (a) is correct option.

29. The correct sequence of plants in a hydrosere is
(a) Oak → Lantana → Scirpus → Pistia → Hydrilla → Volvox
(b) Volvox → Hydrilla → Pistia → Scirpus → Lantana → Oak
(c) Pistia → Volvox → Scirpus → Hydrilla → Oak → Lantana
(d) Oak → Lanatan → Volvox → Hydrilla → Pistia → Scirpus

Ans : **FOREIGN 2012**

The various stages in a hydrosere are well studied in ponds, pools or lakes. The various stages of hydrosere are:
1. **Phytoplankton Stage**, e.g. some blue-green algae, green algae (Volvox), diatoms and bacteria, etc.
2. **Rooted Submerged Stage**, e.g. Hydrilla, Vallisneria, etc.
3. **Floating Stage**, e.g. Nelumbo, Nymphaea, etc. Some free floating species are Pistia, Azolla, Lemna, etc.
4. **Red-swamp Stage**, e.g. species of Scirpus, Typha, etc.
5. **Sedge-meadow Stage**, e.g. species of Cyperaceae and Gramineae.
6. **Woodland Stage**, e.g. Lantana, Salix, Populus, etc.
7. **Forest Stage**, e.g. Tropical rain forests, mixed forests of Almus, Acer, Quercus (oak), tropical deciduous forests.

Thus (b) is correct option.

30. Which one of the following types of organisms occupy more than one trophic level in a pond ecosystem?
(a) Phytoplankton (b) Fish
(c) Zooplankton (d) Frog

Ans : **COMP 2013**

In a pond ecosystem, fishes occupy more than one trophic levels. Small fishes act as secondary consumer. They feed on primary consumer. Large fishes act as Tertiary consumer. They feed on smaller fish.
Thus (b) is correct option.

31. Quercus species are the dominant component in
(a) temperature deciduous forests
(b) alpine forests
(c) scrub forests
(d) tropical rain forests

Ans : **OD 2012**

Temperate deciduous forests grow in continental climates with summer rainfall and severe winters. They are dominated by broad leaved deciduous trees like Quercus virginiana, magnolias, bays and hallies as well as such tropical species as Ficus aurea and Lysiloma.
Thus (a) is correct option.

32. Consider the following statements concerning food chains.
I. Removal of 80% tigers from an area resulted in greatly increased growth of vegetation.
II. Removal of most of the carnivores resulted in an increased population of deers.
III. The length of food chains is generally limited to 3-4 trophic levels due to energy loss.
IV. The length of food chains may vary from 2 to 8 trophic levels.
Which of the two above statements are correct?
(a) I and II (b) II and III
(c) III and IV (d) I and IV

Ans : **DELHI 2012**

Statement II and III are correct. A simple food chain consists of producers, herbivores and carnivores. The length of food chain is generally limited to 3-4 trophic levels due to the energy loss. In grazing food chain the producers (i.e. plants) are eaten by herbivores (i.e. rabbit, deer, cow, etc.) and the herbivores are eaten by carnivores. Therefore, the removal of most of the carnivores resulted in an increased population of deers.
Thus (a) is correct option.

33. About 70% of total global carbon is found in
(a) grasslands (b) agroecosystems
(c) oceans (d) forests

Ans : **SQP 2020**

Sea water contains 50 times more CO_2 than air. i.e. about 70% of total global carbon is found in oceans. This is in form of carbonates and bicarbonates. The atmosphere is the source of CO_2, which is utilised by plants in photosynthesis reduced to form carbon compounds. The total mass of carbon currently in the atmosphere is about 7×10^{17} g, i.e. 700000 million tonnes. Oceans regulate the CO_2 content in the atmosphere and thus, play a very important role.
Thus (c) is correct option.

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CHAPTER 12

ECOSYSTEM

SUMMARY

1. ECOSYSTEM

The ecosystem consists of two basic components: (i) **abiotic** (inorganic material and soil, water, etc.) and (ii) **biotic** (producer, consumer and decomposer organisms). The ecosystem refers "to a functional unit of nature and comprises abiotic and biotic components".

2. ECOSYSTEM-STRUCTURE AND FUNCTION

Abiotic components of ecosystem are CO_2, O_2, water, inorganic materials, fats, proteins, carbohydrates and humid substances. **Biotic components** of ecosystem comprise the kinds, number and distribution of living organs.

3. PRODUCTIVITY

It is the main function of an ecosystem. It is related to production of food in ecosystem. The chemical energy is also released from dead animals and plants. The productivity is "the rate of biomass production by the producers." It may be primary and secondary productivity.

Net productivity = Gross productivity

– Respiration rate

or NPP = GPR-R

Net primary productivity results in the accumulation of plant biomass which serves as the food of **herbivores** and **decomposers**.

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4. POND

It is an example of an **aquatic ecosystem**. It shows all the **basic components** of an ecosystem.

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Table: A Small Pond Ecosystem

1.	**Abiotic Components**	Dissolved inorganic plus organic subtances, rich soil deposit at bottom of a pond, solar input, temperature, wind, climatic conditions there.
2.	**Biotic Components**	Phytoplanktons, algae, free swimming, bottom dwelling organisms, submerged plants, fungi, bacteria etc.

5. DECOMPOSITION

It is another main function of the ecosystem. Decomposition includes 3 processes. They are :

1. Fragmentation of detritus,
2. Leaching and
3. Catabolism.

6. HUMIFICATION

It leads "to the accumulation of a dark coloured amorphous substance the humus." Humus is highly resistant to microbial action. It undergoes decomposition at a very **slow rate**. Further degradation of humus occurs by certain microbes. The **mineralisation** is the process of release of the inorganic substances/nutrients. Some of the nutrients **leach** into the soil.

7. ENERGY FLOW

It is the function of an ecosystem. The **energy flow** is **unidirectional** i.e., one way. The plants capture solar energy and prepare food. The food is transferred from the producers to the **decomposers**. Sun provides energy.

Energy is essential for **circulation of matter** and for the **maintenance of life**.

7.1 Food Web and Food Chains

The organisms of various **trophic levels** in nature are related to each other for food o energy

1.97%) occurs as frozen ice caps and glaciers and 0.5% fresh water occurs as ground water.
Thus (d) is correct option.

40. Which one of the following pair is mismatched?
(a) Biomass burning-Release of CO_2
(b) Fossil fuel burning-Release of CO_2
(c) Nuclear power-Radioactive wastes
(d) Solar energy-Green house effect

Ans : **FOREIGN 2019**

Solar energy is not responsible for green-house effect instead it is a source of energy for the plants and animals. Green plants prepare their food by the use of this solar energy. CO_2 gas is mainly responsible for greenhouse effect. Excess of this gas forms a thick layer around the earth and prevents re-radiation of earth climate entering sun rays to atmosphere. Thus, functions like the glass panels of a green house (or the glass windows of a motor car). This is thus, called greenhouse effect.
Thus (d) is correct option.

41. Which of the following is expected to have the highest value ($gm/m^2/yr$) in a grassland ecosystem?
(a) Secondary Production (SP)
(b) Tertiary Production (TP)
(c) Gross Production (GP)
(d) Net Production (NP)

Ans : **COMP 2015**

The rate of total capture of energy or rate of total production of organic material is gross primary productivity while the balance or biomass remaining after meeting the cost of respiration of producers is net primary productivity. Hence, gross productivity has highest value in grassland ecosystem.
Thus (c) is correct option.

42. If by radiation all nitrogenase enzymes are inactivated, then there will be no
(a) fixation of nitrogen in legumes
(b) fixation of atmospheric nitrogen
(c) conversion from nitrate to nitrite in legumes
(d) conversion from ammonium to nitrate in soil

Ans : **OD 2016**

The enzyme nitrogenase is required for the process of biological nitrogen fixation in legumes. Fixation of atmospheric nitrogen occur through other route also. Neither nitrification (conversion of ammonium to nitrate) nor conversion of nitrate to nitrite require nitrogenase.
Thus (a) is correct option.

43. An ecosystem which can be easily damaged but can recover after some time if damaging effect stops, will be having
(a) low stability and high resilience
(b) high stability and low resilience
(c) low stability and low resilience
(d) high stability and high resilience

Ans : **DELHI 2008**

Stability is the power of a system to be in their state against unfavourable factor. Resilience is the capability or regaining its original shape of position after being deformed. Hence, it has low stability and high resilience.
Thus (a) is correct option.

44. The maximum biomagnification would be in which of the following in case of aquatic ecosystem?
(a) Fishes (b) Phytoplanktons
(c) Birds (d) Zooplanktons

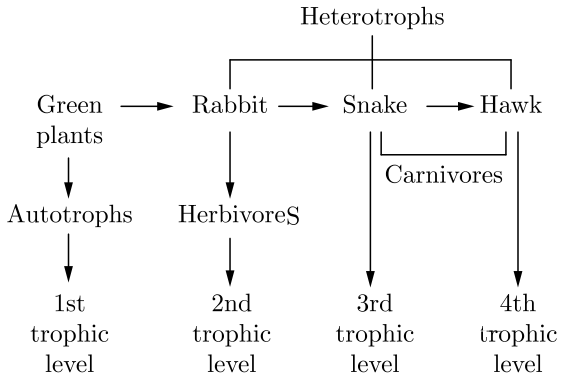
Ans : **FOREIGN 2005**

Non-degradable chemicals enter the food chain and their concentration goes up as they move up in the food chain. This phenomenon is called **biomagnification**. Naturally in a food chain, Phytoplankton → Zooplankton → Fishes → Birds, it would be highest in fishes.
Thus (a) is correct option.

45. Bamboo plant is growing in a far forest then what will be the trophic level of it?
(a) First trophic level (T_1)
(b) Second trophic level (T_2)
(c) Third trophic level (T_3)
(d) Fourth trophic level (T_4)

Ans : **OD 2008**

Plants, being photosynthetic, occupy first trophic level (T_1) in the food chain.



A trophic level is a step in the flow of energy through an ecosystem, such as the step at which plants manufacture food or the at which carnivores feed on other animals.

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Thus (a) is correct option.

46. The greatest biomass of autotrophs in the world's oceans is that of
(a) benthic brown algae, coastal red algae and dephnids.
(b) benthic diatoms and marine viruses.
(c) sea grasses and slime molds.
(d) free-floating micro-algee, cyanobaceria and nanoplankton.

Ans : SQP 2017

The greatest biomass of autotrophs in the world's ocean is that of free floating micro-algae, cyanobacteria and nanoplankton. Phytoplanktons, diatoms and dinoflagellates are the dominant producers in the world's cceans.
Thus (d) is correct option.

47. The transfer of energy from one trophic level to another is governed by the 2nd law of thermodynamics. The average efficiency of energy transfer form herbivores to carnivores is
(a) 5% (b) 10%
(c) 25% (d) 50%

Ans : FOREIGN 2016

According to 10% law of **Lindeman**, only 10% of energy is transferred from one trophic level to another, i.e. from herbivores to carnivores.
Thus (b) is correct option.

48. Drawback of DDT as pesticide is
(a) it becomes ineffective after some time.
(b) it is less effective than others.
(c) it is not easily/rapidly degraded in nature.
(d) its high cost.

Ans : OD 2007

DDT is non-degradable and so accumulates in the environment and its concentration increases as it pass from organisms of one trophic level to another resulting into highest concentration in man.
Thus (c) is correct option.

49. The plant which bears clinging roots is
(a) Podostemon (b) orchid
(c) Trapa (d) Screwpine

Ans : COMP 2008

Clinging roots are modified adventitious roots meant for providing mechanical support. These arise from the axils of leaves or nodes of the stem and pierce the substratum plant to facilitate fixation e.g. orchids, ivy.
Thus (b) is correct option.

50. The response of different organisms to the environmental rhythms of light and darkness is called
(a) phototaxis (b) phototropism
(c) vernalisation (d) photoperiodism

Ans : DELHI 2017

Photoperiodism is the term to denote a biological response to changes in the ratio of light and darkness in a 24 hour cycle.
Thus (d) is correct option.

51. Warm ocean surge of the Peru current recurring every 5 to 8 year or so in the East Pacific of South America is widely known as
(a) Magnox (b) Gull stream
(c) El Nino (d) Aye Aye

Ans : SQP 2018

EL Nino is a warm ocean surge of Peru current (flowing North from Antarctica along the West coast of South America to South Equador, the West). It recurs every 5-8 year or so, in the East Pacific of South America.
Thus (c) is correct option.

52. In a terrestrial ecosystem such as forest, maximum energy is in which trophic level?
(a) T_1 (b) T_2
(c) T_3 (d) T_4

Ans : OD 2005

There is 90% loss of energy at every trophic level. Therefore, maximum energy is at T_1 level.
Thus (a) is correct option.

53. Plants such as Prosopis, Acacia and Capparis represent examples of tropical
(a) grasslands (b) thorn forests
(c) deciduous forests (d) evergreen forests

Ans : COMP 2008

Flora of thorn forests include Prosopis cinearia, Acacia senagal, Capparis decidua, Salvadora oleoides, Aspaagus racemosus and Ephedra foliata.
Thus (b) is correct option.

54. The rate at which light energy is converted into chemical energy of organic molecules is the ecosystem's
(a) net primary productivity
(b) gross secondary productivity
(c) net secondary productivity
(d) gross primary productivity

Ans : OD 2009

Plants, found in an ecosystem are known as producers, because they can prepare food for

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themselves by the process of photosynthesis. The energy fixed by the autotrophs during photosynthesis gets incorporated into organic compounds. The rate at which organic molecules are formed in a green plant (or a population of green plants) is called gross primary productivity.
Thus (d) is correct option.

55. Which of the following ecosystem has the highest gross primary productivity?
(a) Grasslands
(b) Coral reefs
(c) Mangroves
(d) Equatorial rain forest

Ans : **OD 2016**

The Gross primary productivity of an ecosystem is the total amount of organic matter produced by it's producers, i.e. autotrophs. Coral reefs have maximum and deserts have lowest productivity.
Thus (b) is correct option.

56. The nature of climax community ultimately depends on
(a) climate
(b) bed rock
(c) soil organisms
(d) pool of available nutrients

Ans : **COMP 2017**

The climax community ultimately depends on the climate such as rain forest in moist tropical area and mixed coniferous or deciduous forest in temperate area.
Thus (a) is correct option.

57. In a food chain, the largest population is that of
(a) decomposers
(b) producers
(c) primary consumers
(d) tertiary consumers

Ans : **DELHI 2015**

Producers are present in largest number in any food chain.
Thus (b) is correct option.

58. If the forest cover is reduced to half, what is most likely to happen on a long basis?
(a) Tribals living in these areas will starve to death
(b) Cattle in these and adjoining areas will die due to lack of fodder
(c) Large areas will become deserts
(d) Crop breeding programmes will suffer due to a reduced availability of variety of germplasm

Ans : **FOREIGN 2012**

If the forest cover is reduced to half than it will lead to desertification (formation of desert) of that area in long term.
Thus (c) is correct option.

59. In a biotic community, the primary consumers are
(a) carnivores (b) omnivores
(c) detritivores (d) herbivores

Ans : **SQP 2013**

In a biotic community, the primary consumers or first order consumers are herbivores, they feed on producers. They are also called **key industry animals** because they convert plant material into animal material, e.g. rat, deer, rabbit, cattle, goat, sheep, insects etc.
Thus (d) is correct option.

60. Which of the following is the most stable ecosystem?
(a) Forest (b) Desert
(c) Mountain (d) Ocean

Ans : **DELHI 2010**

Oceanic biome or ecosystem occupies more than two-thirds of the earth's surface. This is the most stable ecosystem.
Thus (d) is correct option.

61. The primary succession refers to the development of communities on a
(a) fleshly cleared crop field
(b) forest clearing after devastating fire
(c) pond, freshly filled with water after a dry phase
(d) newly-exposed habitat with no record of earlier vegetation

Ans : **SQP 2020**

Primary succession is the succession in a totally barren area with no record of earlier vegetation. It takes long time of 1000 year or more.
Thus (d) is correct option.

62. Which of the following pair is a sedimentary type of biogeochemical cycle?
(a) Oxygen and nitrogen
(b) Phosphorous and sulphur
(c) Phosphorous and nitrogen
(d) Phosphorous and carbon dioxide

Ans : **COMP 2011**

In sedimentary cycle the reservoir for the elements is in the sediments of earth (lithosphere), e.g. phosphorus, calcium, magnesium, sulphur.
Thus (d) is correct option.

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63. If we completely remove the decomposers from an ecosystem, its functioning will be adversely affected because
(a) energy flow will be blocked.
(b) herbivores will not receive solar energy.
(c) mineral movement will be blocked.
(d) rate of decomposition will be very high.

Ans : COMP 2016

Decomposers like fungi, bacteria and Actinomycetes are also called mineralisers as they release minerals trapped in organic matter. Thus, they help in recycling of minerals, so if we completely remove decomposers the mineral movement will be blocked.
Thus (c) is correct option.

64. In grass-deer-tiger food chain, grass biogas is one tonne. The tiger biomass shall be
(a) 100 kg (b) 10 kg
(c) 200 kg (d) 1 kg

Ans : DELHI 2011

According to 10% law of Lindemann, if 1 tonne (1000 kg) biomass is present in grass, only 10% of it means 100 kg will go into deer and in tiger the biomass will be only 10 kg, i.e. 10% of deer's biomass.
Thus (b) is correct option.

65. Second most important trophic level in a lake is
(a) zooplankton (b) phytoplankton
(c) benthos (d) neuston

Ans : OD 2016

In a lake ecosystem, the first trophic level is occupied by phytoplankton and then in second trophic level there are zooplanktons which are primary consumers.
Thus (a) is correct option.

66. Xeric environment is characterised by
(a) precipitation
(b) low atmospheric humidity
(c) extreme of temperature
(d) high rate of vapourisation

Ans : SQP 2011

Xeric environment is characterised by low atmosphiric humidity. This environment is found in deserts.
Thus (b) is correct option.

67. Bulk CO_2-fixation occurs in
(a) crop plants
(b) oceans
(c) tropical rain forests
(d) temperature forests

Ans : COMP 2015

Bulk CO_2-fixation occurs in oceans. The productivity of ocean ecosystem is very high, here phytoplanktons, e.g. diatoms are the greatest producers.
Thus (b) is correct option.

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68. The pyramid which cannot be inverted in a stable ecosystem is that of
(a) biomass (b) number
(c) energy (d) All of the above

Ans : OD 2005

Pyramid of energy is graphic representation of amount of energy trapped per unit time and area in different trophic levels of a food chain with producers forming the base and top carnivores or consumers the tip. It is always **upright** in shape.
Thus (c) is correct option.

69. Pyramid of number in a pond ecosystem is
(a) irregular (b) inverted
(c) upright (d) spindle-shaped

Ans : FOREIGN 2015

Pyramid of number in a pond ecosystem is upright of erect, in which producers are maximum in number and top consumers are least in number.
Thus (c) is correct option.

70. Pyramid of number deals with number of
(a) species in an area
(b) individuals in a community
(c) individuals in a trophic level
(d) sub-species in a community

Ans : OD 2009

Pyramid of number is a graphic representation of the number of organisms per unit area of various trophic levels. It deals with the number of individuals in a trophic level. It deals with the number of individuals in a trophic level.
Thus (c) is correct option.

71. Food chain in which micro-organisms breakdown the food formed by primary producers are
(a) parasitic food chain
(b) detritus food chain
(c) consumer food chain
(d) predator food chain

Ans : SQP 2013

Detritus food chain goes from dead organic matter to detritivorous protozoa, bacteria, fungi

and then to organisms feeding on detritivores, e.g. insect larva, nematodes. This food chain is also called as saprophytic food chain.
Thus (b) is correct option.

72. Which of the following food chain is correct ?
(a) Grass → Chameleon → Insect → Bird
(b) Grass → Fox → Rabbit → Bird
(c) Phytoplankton → Zooplankton → Fish
(d) Fallen leaves → Bacteria → Insect larvae

Ans : SQP 2006

The correct food chain as:
Phytoplankton → Zooplankton → Fish
i.e. Producers → Primary consumer → Secondary consumer
Thus (c) is correct option.

73. What is true of ecosystem?
(a) Primary consumers are least dependent upon producers
(b) Primary consumers out-number producers
(c) Producers are more than primary consumers
(d) Secondary consumers are the largest and most powerful

Ans : FOREIGN 2015

In an ecosystem producers (green plants) are always more than primary consumers (herbivores).
Thus (c) is correct option.

74. In an ecosystem, which one shows one-way passage
(a) free energy (b) carbon
(c) nitrogen (d) potassium

Ans : DELHI 2010

The flow of energy in any ecosystem is unidirectional. The only source of energy is sunlight. It gets trapped by producers then it flows from herbivores to carnivores or consumers at different trophic level.
Thus (a) is correct option.

75. Upper part of sea/aquatic ecosystem contains
(a) plankton (b) nekton
(c) Both (a) and (b) (d) benthos

Ans : COMP 2015

Planktons are passively floating organisms living in the surface layers of water due to absence of locomotory organs, they are of two types:
Phytoplankton (photosynthetic plankton) and zooplankton.While nektons are actively floating organisms and benthos are found in the bottom and are usually sessile.
Thus (a) is correct option.

ASSERTION AND REASON

DIRECTION : Each of these questions contains as Assertion following by Reason. Read them carefully and answer the question on the basis of following options. You have to select the one that best describes the two statements.

76. **Assertion :** A network of food chains existing together in an ecosystem is known as food web.
Reason : An animal like kite cannot be a part of a food web.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : OD 2011

In the food web, different food chains are interconnected. Each chain is interconnected and consists of different trophic levels i.e. producers, consumers and detrivorous. So, kite can also be a part of food web.
Thus (c) is correct option.

77. **Assertion :** Biotic community has higher position than population in ecological hierarchy.
Reason : Population of similar individuals remains isolated in the community.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : COMP 2019

The organisms of all the species that live in a particular area and interact in various ways with one another form biotic community. Biotic community is a grouping that is higher than population in ecological hierarchy. It is an assemblage of all the populations of different organisms occurring in an area. The different populations of a community do not remain isolated. They show interactions and interdependence.
Thus (c) is correct option.

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101. List any two ways of measuring the standing crop of a trophic level.

Ans : **FOREIGN 2010**

Two ways of measuring the standing crop of atrophic level are

(i) Biomass of living organisms.

(ii) Number in an unit area.

102. What do you understand by the term seral stage?

Ans : **COMP 2007**

An individual transitional community in ecological succession.

103. Under what conditions would a particular stage in the process of succession revert back to an earlier stage?

Ans : **SQP 2014**

Natural or human induced disturbances like fire, deforestation, etc.

104. Name a major reservoir of carbon on earth.

Ans : **OD 2011**

Ocean.

105. How much of carbon is dissolved in the oceans?

Ans : **FOREIGN 2005**

About 71%.

106. Name the two forms of reservoir of carbon, that regulate the ecosystem carbon cycle.

Ans : **SQP 2018**

Atmosphere and oceans.

107. How much carbon is fixed in the biosphere through photosynthesis annually?

Ans : **FOREIGN 2006**

4×10^{13} kg.

108. Name the basic requirement of any ecosystem to function and sustain.

Ans : **COMP 2005**

Biotic and abiotic factors.

109. Which are more numerous, secondary consumers or tertiary consumers?

Ans : **OD 2010**

Secondary consumers.

110. Which two major groups of organisms make up the bulk of decomposers?

Ans : **DELHI 2015**

Fungi and bacteria.

111. In which case, the pyramid of number is inverted?

Ans : **SQP 2020**

In a tree ecosystem.

112. What does the base tier of ecological pyramid represent?

Ans : **FOREIGN 2013**

Producer or first trophic level.

113. What are series?

Ans : **COMP 2016**

The entire sequence of communities that change in a given area.

SHORT ANSWER QUESTIONS

114. Write in brief about nitrogen fixation from atmosphere.

Ans : **OD 2016**

The cyclic process by which nitrogen is circulated continuously through the living and non-living components of the biosphere is called nitrogen cycle. It has following stages.

1. **Nitrogen Fixation :** In it, free atmospheric nitrogen gas is converted into compound of nitrogen It takes place physically in atmosphere during lightning while on earth surface it is biologically performed by nitrogen-fixing bacteria, Azotobacter and Clostridium and symbiotic bacteria like Rhizobium associated with root nodules of certain leguminous plants like pulses, pea, beans, etc. These microbes fix atmospheric nitrogen into nitrates.
2. **Nitrogen Assimilation :** Along with water, plants absorb inorganic nitrogen compounds, i.e., nitrates and ammonium salts and convert them into amino acids, nucleotides and other nitrogenous compounds. These proteins and other complex compounds are subsequently consumed by animals.
3. **Ammonification :** In it, Complex organic compounds like proteins and nucleic acids of dead and decaying organisms is converted into ammonia. It is carried out by several heterotrophic bacteria, actionmycetes and fungi present in soil and water.
4. **Nitrification :** Here, ammonia is converted into nitrites and nitrates by nitrifying bacteria in the soil.
5. **De Nitrification :** This process involves the conversion of nitrate salts present in the soil or water into free molecular nitrogen. Denitrifying bacteria such as Pseudomonas carry out this conversion.

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86. Mention any two reasons why the primary productivity varies in different types of ecosystems?

Ans : OD 2014

The primary productivity varies in different types of ecosystems as

(i) It depends upon plant species (producers) of a given ecosystem and their photosynthetic capacity.

(ii) It is dependent on various environmental factors like availability of nutrients.

87. What does 'R' represent in the given equation for productivity in an ecosystem?
GPP - R = NPP

Ans : DELHI 2014

In the given equation for productivity in an ecosystem,

$$GPP - R = NPP.$$

'R' represents the energy utilised by plants or producers in respiration. It is also referred to as respiration losses.

88. Write the equation that helps in deriving the net primary productivity of an ecosystem.

Ans : COMP 2012

Net Primary Productivity (NPP) is the weight of the organic matter stored by the producers which is available to heterotrophs for consumption. It is equal to the rate of organic matter produced during photosynthesis GPP minus respiratory losses (R), i.e. NPP = GPP - R.

89. Write a difference between net primary productivity and gross primary productivity.

Ans : OD 2011

Difference between GPP and NPP is

Gross Primary Productivity (GPP)	**Net Primary Productivity (NPP)**
It is the rate of production of biomass/organic matter by producers during photosynthesis	It refers to the biomass/organic matter available for the consumption to heterotrophs, left after some respiratory losses.

90. Mr. Galgotia eats curd/yoghurt. In this case, which trophic level will he occupy?

Ans : COMP 2018

Tertiary consumer.

91. Name the common detritivores in an ecosystem .

Ans : SQP 2020

Earthworms.

92. Define mineralisation.

Ans : FOREIGN 2010

The process of degradation of humus by microbial action and release of inorganic nutrients.

93. Mention one similarity between hydrarch and xerarch successions.

Ans : OD 2010

Both succession lead to medium water conditions (mesic), neither too dry, nor too wet.

94. Expand PAR.

Ans : FOREIGN 2013

Photosynthetically Active Radiation.

95. Man can be a primary as well as secondary consumer'. Justify this statement.

Ans : FOREIGN 2015

Man can be a primary as well as secondary consumer because man eats plants as well as meat of other animals.
So, man is herbivores as well as carnivores.

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96. What is the starting point of a grazing food chain and of a detritus food chain?

Ans : DELHI 2012

Producers and dead organic matter, respectively.

97. Name any two organisms, which can occupy more than one trophic level in an ecosystem.

Ans : COMP 2016

Human being (man) and birds (sparrow) can be frequently seen in more than one trophic level, in an ecosystem.

98. Why is a food web formed in nature?

Ans : SQP 2008

Food web is formed by interconnecting food chains.

99. Define trophic level.

Ans : OD 2024, 2017

Trophic level is the specific position of an organism in the food chain.

100. State what does standing crop of a trophic level represent.

Ans : OD 2013

Standing crop represents total amount of living matter or organic matter present in an ecosystem in an unit area and at a specific time.

78. **Assertion :** Net primary productivity is gross primary productivity minus respiration.
Reason : Secondary productivity is produced by heterotrophs.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **COMP 2020**
Net primary productivity is the rate of organic matter build up or stored by producers in their bodies per unit time and area. Net productivity is equal to gross primary productivity minus loss due to respiration and other reasons. Rate of increase in energy containing organic matter or biomass by heterotrophs or consumers per unit time and area is known as secondary productivity.
Thus (b) is correct option.

79. **Assertion :** In a food chain, members of successive higher levels are fewer in number.
Reason : Number of organisms at any trophic level depends upon the availability of organisms which serve as food at the lower level.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **OD 2006**
When food is made available, automatically the next higher level of organism in the hierarchy should increase. This is because when the forest cover got depleted it led to the increase in the number of endangered species. If the deer population is more, it automatically leads to an increase in the tiger population.
Thus (d) is correct option.

80. **Assertion :** Pyramid of energy may be upright or inverted.
Reason : Only 20% of energy goes to next trophic level.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **FOREIGN 2020**
Energy flow in the ecosystem is a unidirectional manner. There is a decline in the amount of energy passing from one trophic level to the next. Thus the pyramid of energy is always upright. According to Lindemann, only 10% of energy goes to next trophic level.
Thus (d) is correct option.

VERY SHORT ANSWER QUESTIONS

81. Net primary productivity. Name the two basic categories of an ecosystem.

Ans : **OD 2010**
Natural and artificial ecosystem.

82. 'Ecosystem is called an interactive system'. Name a functional aspect of ecosystem which justifies the above statement.

Ans : **DELHI 2016**
Energy exchange and flow of nutrient cycling (any one).

83. How is stratification represented in forest ecosystem?

Ans : **DELHI 2014**
Stratification is the way in which different species in an ecosystem are placed or arranged vertically, occupying different levels. It is a way of minimising competition for limited resources vital for survival

84. Why are green algae not likely to be found in the deepest strata of the ocean?

Ans : **OD 2013**
Green algae are autotrophic organisms, i.e. they synthesise their own food with the help of photosynthesis. At deepest layers of ocean, light is absent. So, photosynthesis does not take place there and hence, green algae are not found in deep strata.

85. All primary productivity is not available for herbivores. Give one reason.

Ans : **DELHI 2009**
Some of the gross primary productivity gets lost in the form of respiration, that is why all primary productivity is not available for herbivores.

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115. Write about man-made ecosystem.

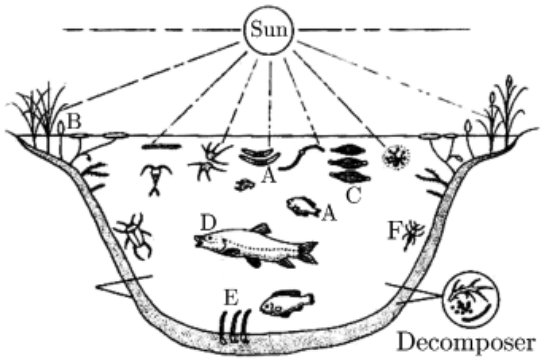
Ans : **OD 2014**

Man-made ecosystem are artificial ecosystem which are artificially created by man. Here, natural balance is continuously disturbed by human interventions eg. croplands, orchards, gardens, aquarium, etc.

These ecosystem have lesser biodiversity as compared to natural systems. Whereas the natural systems do not have definite goals and envolved by trial and error and their survival value, the man-made ecosystem is pragmatic with well defined goals. Man-made systems are more fragile and are more vulnerable to failure due to lack of diversity and strong self regulatory systems, characterizing the natural systems.

116. Show well labelled diagrammatic representation of an aquatic/pond ecosystem.

Ans : **OD 2014**



A- Primary consumer
B- Producer
C- Phytoplankton
D- Tertiary consumer
E- Secondary consumer
F- Minute floating plankton

117. What do you understand by an ecosystem?

Ans : **OD 2011**

The term ecosystem was proposed by A.C. Tansley in 1935. Ecosystem may be defined as the system resulting from the integration of all living and non-living factors of the environment. Thus, any structural and functional unit of biosphere where the organisms interact with the physical environment so that a flow of energy leads to clearly defined trophic structure, biotic diversity and material cycle (i.e., exchange of materials between living and non-living components)within the system is known as an ecological system or ecosystem.

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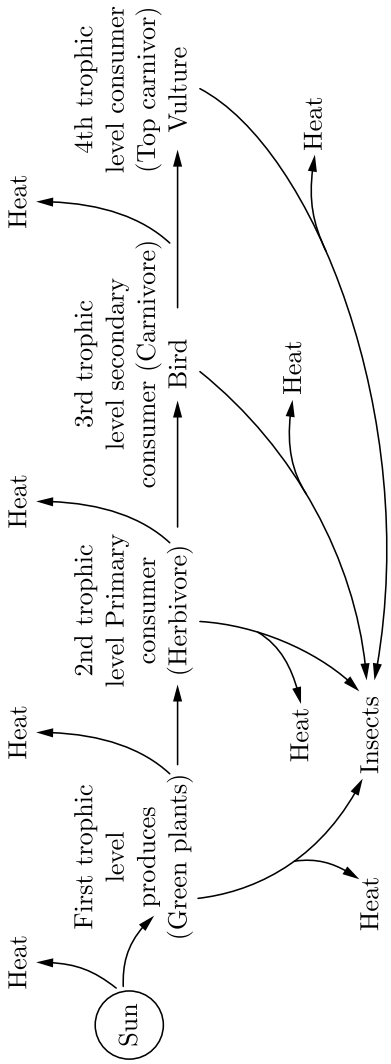
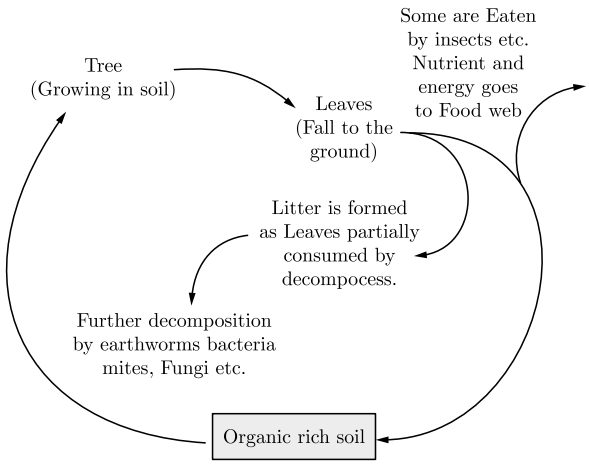
118. Draw an arrow diagram showing energy flow through different trophic levels.

Ans : **COMP 2011**



119. Give graphic representation of decomposition cycle in a terrestrial ecosystem.

Ans :



120. Describe the components of an ecosystem.

Ans : **DELHI 2016**

The main components of the ecosystem are: biotic and abiotic (1) Producers (2) Consumers (3) Decomposers are biotic components. The abiotic components are soil, water, temperature, light etc. The **producers** are green plants, algae, phytoplankton etc. who undergo photosynthesis and capture the solar energy. They produce organic food. The consumers are herbivores and carnivores both. In aquatic eco-systems, zooplanktons are the primary consumers, fishes are the primary and secondary consumers, both. Similarly in a forest ecosystem, the producers are green plants of different types. Primary consumers are the grass eating animals including human beings (herbivores). The secondary consumers are meat eaters and they eat the herbivores and finally there are top consumers or top carnivores like vultures etc. The **decomposers** are the bacteria and fungi. They breakdown the dead organic matter of dead plants and animals to simpler inorganic forms. These are taken up by green plants from the soil and again converted into organic food using solar energy.

Thus producers are autotrophs and consumers are **heterotrophs. Decomposition leads to mineralisation** of dead matter for reuse by autotrophs. These events keep on being repeated in the ecosystem.

121. What is primary productivity? Give brief description of factors that affect primary productivity.

Ans : **SQO 2019**

The rate of production of biomass is termed productivity. The Gross primary productivity is the rate of production of organic matter of an ecosystem during photosynthesis. The net primary productivity is gross primary productivity minus losses due to respiration.

Hence, $\text{GPP} - \text{R} = \text{NPP}$.

Thus the available biomass for the consumption of heterotrophs is net primary productivity.

Primary productivity of a particular area depends upon the plant species growing there. Environmental factors also control the primary productivity. Photosynthetic ability of plants and available nutrients also affect the primary productivity. Therefore, it is variable in different ecosystem.

122. Define decomposition and describe the processes and products of decomposition.

Ans : **FOREIGN 2011**

The process of breakdown of complex organic matter into simple inorganic substances like nutrients, carbon dioxide and water is called decomposition.

The important steps of decomposition are:

(1) Fragmentation, (2) leaching, (3) catabolism, (4) humification and (5) mineralization.

Fragmentation is the break down of detritus into smaller particles by detrivores like earthworms.

Leaching is the perolation of water soluble salts into soil.

Catabolism is degradation of detritus into simple inorganic substances.

Humification is accumulation of dark coloured amorphous substance called humus. It is highly resistant to microbial action.

Mineralization is further breakdown of humus by microbes to release the inorganic nutrients. Decomposition requires oxygen supply. Climatic factors and chemical nature of deteritus also determine the decomposition rate. The most important climatic factors for decomposition are soil moisture and temperature. Warm and moist conditions help in decomposition.

123. Give an account of energy flow in an ecosystem.

Ans : **SQP 2009**

Sun is the primary source of energy for all ecosystem except for the deep hydrothermal ecosystem in sea. Green plants and photosynthetic bacteria convert solar energy into organic food using minerals, water and carbon dioxide. Plants can take up only 2-10 percent of PAR. Thus green plants are producers. All other organisms are dependent on producers for their food. Solar energy captured by plants flows through different organisms of the ecosystem. There is thus a unidirectional flow of energy from sun to producers to consumers.

Different organisms are placed in a community according to their relationships of called **trophic level. Producers** are placed in first trophic level, **herbivores** in the second and carnivores in the third trophic level.

The amount of energy transferred from one trophic level to the next is only 10%. There is thus decrease in energy at successive higher trophic levels. Due to this 10% law of energy transfer, there is decreased number of trophic levels in the grazing food chains.

124. Write important features of a sedimentary cycle in an ecosystem.

Ans : **OD 2006**

Phosphorus cycle is a sedimentary cycle. The natural reservoir of phosphorus is rock, that has

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phosphates. Small amounts of phosphates get dissolved in soil solution. These are absorbed by plant roots. Herbivorus obtain phosphorus from plants. There is no release of phosphorus into atmosphere. There is negligible exchange of phosphorus in gaseous form between environment and organisms. Similarly, phosphorus input in atmosphere through rainfall is mush lesser than inputs of carbon.

125. Outline important features of carbon cycling in an ecosystem.

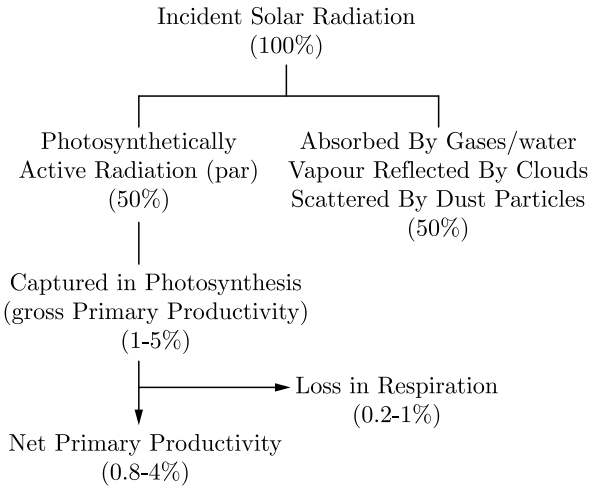
Ans : **FOREIGN 2014**

About 70% of the total quantity of global carbon is present dissolved in ocean water. The atmosphere has only 1% of total global carbon. Cycling of carbon takes place through atmospheric ocean and the organisms. A huge amount of CO_2 is fixed through photosynthesis per year. A good amount of this CO_2 is returned to atmosphere through respiration of producers and consumers. Decomposes also add a good amount of CO_2 into atmosphere. Burning of fuels, combustion of organic matter and forest fires and volcanoes also release CO_2 in the atmosphere. Burning of fossil fuels for transport and energy have already increased the release rate of CO_2 into the atmosphere. Rapid deforestation has also increased CO_2 levels in oxygen. All these human activities are responsible for green-house effect and global warming.

126. Write a note on Solar energy and show diagrammatically the fate of solar radiation incident on plant canopy.

Ans : **COMP 2012**

Solar Energy : Energy from sun is the ultimate source of energy in all the living systems of earth. Enormous energy is released at every moment from the sun and it is spread out in the space. Just 1% total sun's energy reach on the earth. It is near about of 12.3×10^{24} calorie each year. But is also true that all of this quantity does not reach on the earth's surface and the reason behind is the components of atmosphere like clouds, smoke and dust particles which change the nature of solar radiations. Some of the amount of energy of the sun which reach on the earth go back to nature, just a small quantity fall on the plants. Thus it is estimated that only the tenth part of 1% of energy of the sun reaching on the earth's surface is used by the plants in photosynthesis and this energy is 4×10^{14} cal per second.



127. Why is it difficult to draw sharp boundaries between ecosystem?

Ans : **OD 2013**

An ecosystem is an area in which the inputs and outputs can be studied across its boundaries and for convenience it is considered a separate entity. However, the ecosystems are not strictly separate. Their boundaries are indistinct and overlapping and some movements of energy and materials, always occur from one ecosystem to another. Thus it is difficult to draw sharp boundaries between ecosystems. e.g., Soil material may be eroded from a forest ecosystem and washed into the adjoining stream or dust blown from a desert ecosystem may deposit over another ecosystem located miles away.

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128. Why is earth considered as closed system so far as materials are concerned?

Ans : **DELHI 2020**

The earth is considered as a closed system so far as materials are considered because there is cycling of materials from non-living and again to non-living which are essential for sustainance and maintenances to life such as oxygen, carbon, nitrogen, water and minerals is finite, no material comes from outside the planet earth.

129. Give a graphic representation of trophic levels in an ecosystem.

162. Explain the conditions affecting the rate of decomposition.

Ans : COMP 2008

Factors affecting decomposition rate are as follows:

(a) **Temperature :** A soil temperature of 25° C and more hastens decomposition. A low temperature of less than 10° C reduces rate of decomposition.

(b) **Moisture :** Moist environment favours decomposition.

(c) **pH:** Neutral and slightly alkaline soils are rich in detritivores, like earthworms and decomposer microbes. Acidity decreases the number of detritivores and decomposers.

(d) **Chemical Composition of Detritus :** In a particular climatic condition, decomposition rate is slower if detritus is rich in lignin and chitin, and quicker, if detritus is rich in nitrogen and water soluble substances like sugars.

(e) **Aerobiosis :** Aerobic conditions are essential for activity of decomposer organisms because decomposition is oxygen requiring process. Anaerobiosis reduces decomposition and causes piling up of detritus.

163. Name the type of food chains responsible for the flow of larger fraction of energy in an aquatic and a terrestial ecosystem respectively. Mention one difference between the two food chains.

Ans : DELHI 2014

Grazing food chain and detritus food chain are the major conduits for flow of energy in aquatic and terrestrial ecosystems, respectively. Differences between grazing food chain and detritus food chain are as follows:

	Grazing Food Chain	**Detritus Food Chain**
1.	The food chain begins with producers as the first trophic level.	The food chain begins with detritivores and decomposers as their first trophic level.
2.	Energy for the food chain comes from sun.	Energy for the food chain comes from organic remains or detritus.

164. Justify the importance of decomposers in an ecosystem.

Ans : FOREIGN 2006

Decomposers are micro-organisms that obtain nourishment from organic remains by secreting digestive enzymes over it. They help in converting complex organic substances into inorganic substances like carbon dioxide, water and nutrient. Sun is an endless source of energy, but the chemical materials of the environment are not inexhaustible. The producers utilise inorganic substances (carbon dioxide, water etc.) and fix solar energy into the chemical energy of organic compounds. This stored energy is then passed to consumers by repeated eating is then passed to consumers by repeated eating and being eaten. Decomposers act on dead animals and plants (organic matter) and return the chemical nutrients to the environment. They also make space available for new producers. Without this, all life will ultimately cease to exist. Thus, the decomposers have a crucial role in the ecosystem. The decomposers are found in the soil and at the bottom of ponds, lakes and oceans.

165. Discuss the relationship between detritus food chain and grazing food chain in a terrestrial ecosystem.

Ans : OD 2009

In a terrestrial ecosystem, producers constitute the first trophic level or base of a food chain. Producers are autotrophic organisms which are able to manufacture organic food from inorganic raw materials in the process of photosynthesis. Part or whole of the plants enters the food chain as food for consumers. Herbivores, the primary consumers feed on plants or plant products.

Primary carnivores prey upon herbivorous animals and are eaten up by secondary carnivores. The top carnivores are the last order consumers or carnivores which are not preyed upon by other animals because of their size and ferociousness.

Decomposers may act on any trophic level. They feed on dead organic remains of plants and animal and return the biological nutrients stored in them to the soil for reuse by autotrophs i.e., they again enter the food chain. Hence, both detritus and grazing food chain are interrelated.

166. Explain with the help of two examples, how the pyramid of number and the pyramid of biomass can look inverted.

Ans : SQP 2011

Pyramid of number is inverted in parasitic food chain. Here, a single large sized producer like tree provides nourishment to several herbivores (e.g., fruit-eating birds) and each herbivore in turn may support a still larger population of parasities. Thus, from the producer towards consumers, the

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2. **Double Consumers :** Organisms like ants, bear, man. These are omnivores. They belong to more than one category e.g., man is a primary consumer when vegetarian and a secondary consumer when non-vegetarian.
3. **Both Producers and Consumers :** There are insectivorous plants which are producers and secondary consumers.
4. **Scavengers and Detritivores :** These are animals which feed on animals killed by predators or on decaying organic matter or dead organisms like earthworms, termites, vultures etc.

134. Name the major kinds of ecosystem.

Ans : **COMP 2019**

An ecosystem can be as small as an edge of pond or as big as ocean. Biotic communities are spread everywhere except snowing highest altitudes. Land, water or air shown presence of living organisms. The major ecosystems of the world are:

Aquatic Ecosystem		**Terrestrial Ecosystem**		**Artificial Man -made Ecosystem**	
(1)	**Marine**	**(3)**	**Forest**		
(a)	Oceans	(a)	Tropical	(a)	Aquarium
(b)	Sea shore (coastal)	(b)	Temperate	(b)	Crop fields
(c)	Brackish	(c)	Taiga	(c)	Spaceship
(2)	**Fresh Water (Lotic)**	**(4)**	**Grasland**	(d)	Garden and parks
(a)	Lakes and revers	(a)	Tropical	(e)	Small fishery tanks
(b)	Spring and ponds	(b)	Temperate	(f)	Animal husbandry
(c)	Swamp	(c)	Desert	(g)	Dams and reservoirs
(d)	Tundra				

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135. Differentiate between producers and decomposers.

Ans : **SQP 2005**

The difference between producers and decomposers are as follows :

	Producers	**Decomposers**
1.	These are green plants which synthesize their own food by the process of photosynthesis. They are also called autotrophs.	These are non-green microorganisms feed on the dead bodies of plants and animals.
2.	They convert the raw materials in the soil, air and water into carbohydrates which give them food.	They enrich the earth by releasing raw materials trapped in dead bodies of the plants and animals.
3.	They are dependent on decomposers for soil nutrients.	They are dependent on plants and animals for their food.

136. Due to uncontrolled excessive hunting, the population of tigers in a forest becomes zero. Discuss the long-term effect of this situation on the population of deer in that forest.

Ans : **FOREIGN 2007**

In a forest ecosystem, the predator food chain occurs like this:

Grass → Deer → Tiger

As a result of excessive hunting, the tiger population in a forest becomes zero. This will lead to an increase in the population of deer. Consequently, the amount of grass in the forest decreases. In long term, if such a situation exists, it will cause a decrease in deer population due to intra-specific competition among dee for grass. Thus, due to excessive grazing the forest may turn into a desert after a long time.

137. Why soil is rich in nutrients in the tropical rain forests?

Ans : **OD 2010**

Soil in tropical rain forests is rich in minerals and humus because the high temperature and moisture and favourable for the decomposition of fallen leaves and dead organic matter by the decomposers, through the process of humification.

138. What is the significance of decomposers?

Ans : **SQP 2016**

The decomposers are bacteria and fungi which obtain their food from organic remains of dead producers and consumers and their waste products. The decomposers play an important role in returning the chemical nutrients to the environment. They also make space for the new producers by consuming their dead and decaying organic matter, otherwise all the nutrients would remain locked in the dead remains of plants and animals and will not be available for recycling and reuse.

139. Define a food chain. Give its important characteristics.

Ans : **FOREIGN 2011**

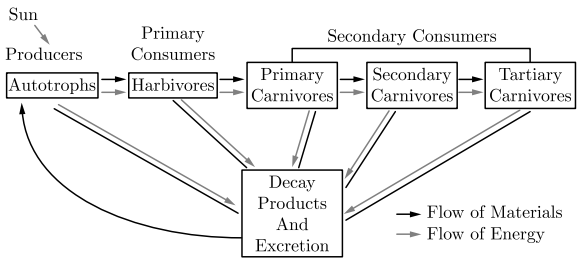
The sequential inter-linking of organisms involving the transfer of food energy from the producers, through a series of organisms is known as a food chain.

Its main characteristics are:

1. In food chain, there occurs repeated eating and being eaten and it involves nutritive interaction between the living organisms;
2. It is always straight;
3. It has undirectional flow of energy;
4. It usually contains 4 to 5 trophic levels;
5. Mostly 80-90% of energy is lost as heat at each trophic level.

140. With the help of a generalised scheme show the flow of materials and flow of energy in an ecosystem.

Ans : **COMP 2006**



141. What is the meaning of the flow of energy in an ecosystem? Explain with example how energy is lost at the various energy levels?

Ans : **DELHI 2019**

In the ecosystem, there is continuous and unidirectional flow of energy. The energy from the sun pass through the various energy levels (= trophic levels) finally reaches the tertiary consumers. These various energy levels are joined to form a food chain. Many food chains overlap and form a food web.

Loss of energy during transformation at different levels

Trapped solar energy is fixed in the form of complex organic compounds and is used by herbivorous and carnivorous animals. But the energy flow does not stop or end here. When the organisms dies, then the dead body gets mixed with the soil. Indirectly it can be said that the complex energy rich compounds from the dead body are now utilized by decomposers or scavengers and then ultimately energy is released back into nature after decomposition, Thus, at every level, organisms make use of energy for performing various life activities accompanied by energy losses and, therefore, for functioning of an ecosystem, supply of energy is continuously required from the sun.

142. What are biogeochemical cycles? Mention their two kinds, giving instances of each.

Ans : **COMP 2020**

The movement of inorganic nutrient elements through the living and the non-living components of the biosphere or of any particular ecosystem, is called biogeochemical cycle.

Two types of biogeochemical cycles are :

1. Gaseous cycles (e.g, oxygen cycle, carbon cycle, nitrogen cycle, water cycle).
2. Sedimentary cycles (e.g., phosphorus cycle, sulphur cycle, calcium cycle, potassium cycle).

143. What is biosphere? What are the main subdivisions of the biosphere?

Ans : **COMP 2015**

All the regions of the world (atmosphere, lithosphere and hydrosphere) where living organisms occur together with their abiotic environments from a biosphere.

Main subdivisions of biosphere are :

1. Atmosphere
2. Lithosphere and
3. Hydrosphere.

144. What are the salient features of the ecosystem nitrogen cycling?

Ans : **OD 2011**

Salient features of ecosystem nitrogen cycle are as follow:

1. Ultimate source of nitrogen is atmosphere which cannot be directly absorbed and metabolised by living organisms.
2. Atmospheric nitrogen fixation and Nitrogen fixing bacterial activities facilitate entry of nitrogen in biological pathway.

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3. Azotobacter and Clostridium are the major free living nitrogen fixing bacteria in the soil.
4. Ammonification is done by many bacteria.
5. Ammonia is converted into nitrite and then nitrate by group of chemoautotrophic bacteria through two step process called nitrification.
6. Mostly plants absorb nitrate from soil.
7. Denitrifying bacteria transforms nitrates in to nitrous and nitric oxides ultimately to gaseous nitrogen.

145. Write a short note on the ecosystem structure.

Ans : **SQP 2017**

Ecosystem structure is as follows:

1. **Species Composition :** Number and type of species differs from one ecosystem to another depending upon geography, topography and climate. Maximum species composition occurs in tropical rain forests and coral reefs. Minimum species diversity occurs in deserts and arctic regions.
2. **Stratification :** It is formation of well defined vertical layers of tall, medium and of small trees, bushes and herbs where vegetation is dense, e.g., 5-7 strata in tropical rain forests. Stratification is absent or rare in deserts.
3. **Trophic Structure :** Each ecosystem has specific food chains and food webs, e.g., grazing food chain in grassland.
4. **Standing Crop :** It is the total amount of living biomass present in an ecosystem. Dry weight preferred over fresh weight because the latter is liable to be influenced by seasonal moist differences.
5. **Standing State :** It is the amount of inorganic nutrients present any time in the soil/water of ecosystem. It tends to very from season to season and ecosystem to ecosystem.

146. Differentiate between food chain and food web.

Ans : **DELHI 2016**

The difference between food chain and food web are as follows :

	Food Chain	**Food Web**
1.	It is a straight single pathway for flow of food energy.	It consists of interconnected and interrelated number of pathways through which food energy passes in the ecosystem.
2.	It does not add to adaptability and competitiveness of the organisms.	Food webs increase adaptability and competitiveness of the organisms.
3.	Members of higher trophic level feed upon a single type of organisms of lower trophic level.	Members of higher trophic level can feed upon a number of alternative organisms of the lower trophic level.
4.	Presence of simple food chains adds instability of the ecosystem.	Presence of food webs in creases the stability of the ecosystem.

147. What are the limitations of ecological pyramids?

Ans : **FOREIGN 2009**

Following are the limitations of ecological pyramids:

1. Ecological pyramids assume that food chains are straight and simple. Simple food chains do not occur in nature. Instead food webs are present.
2. Ecological pyramids have no place for detrivores and decomposers though they play an important role in ecosystem.
3. A simple species may operate at two or more trophic levels. Ecological pyramids have no method to accomodate such cases.

148. Define the rerms (1) Productivity (2) Reserve pool and (3) Cycling pool.

Ans : **COMP 2008**

1. **Productivity :** The rate of synthesis of energy containing organic matter or biomass by any trophic level per unit area in unit time is described as its productivity. It is measured as weight (e.g., $g/m^2/yr$) or energy (e.g., $KCal/m^2/yr$).
2. **Reserve Pool :** It is the reservoir of biogenetic nutrients from which the latter are slowly transferred to cycling pool, e.g., phosphates in rocks. Rate of release of nutrients depends upon environmental factors like moisture, pH, temperature, soil etc. The reservoir pool meet deficient of nutrient which occurs due to differences in rate of influx and efflux.
3. **Cycling Pool :** It is the pool of biogenetic nutrients which is being emptied and filled repeatedly by exchange between biotic and abiotic component of an ecosystem.

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149. Under what circumstances does the secondary succession begin? Why does it proceed faster than primary succession?

Ans : **DELHI 2020**

Secondary succession begins in the area, which become secondarily bared due to the destruction of community completely in the past because of floods, drought, landslides, over grazing, forest fires etc. It proceeds faster than primary succession because the soil is biologically fertile and has organic matter.

150. Define a climax community. How does a sere differ from a serial community.

Ans : **FOREIGN 2005**

Climax community is the stable, self-perpetuating and final biotic community that develops at end of biotic succession and is in perfect harmony with physical environment. Climax community remains stable as long as the environmental remain unchanged.

Sere represent the entire sequence of developmental stages of biotic succession from pioneer to a climax community while a serial community is a biotic community that develop during the progression of biotic succession.

151. The number of trophic levels in an ecosystem are limited. Comment.

Ans : **COMP 2008**

In a food chain, only 10% of the total amount of energy is passed on to the next trophic level from the previous trophic level. So there is a decrease in the amount of energy available at the successive trophic levels. As we more higher up in the food chain, the amount of energy diminishes to a level at which it cannot sustain any trophic level, thereby limiting the number of trophic levels.

152. What could be the reason for the fast rate of decomposition in the trophics ?

Ans : **OD 2016**

The rate of decomposition is regulated by climatic factors like temperature and soil moisture as they have an effect on the activities of soil microbes. The tropics with its hot and humid climatic condition provides an environment which is ideal for the microbes to speed up the process of decomposition.

153. Flow of energy through various trophic levels in an ecosystem is unidirectional and non-cyclic. Explain.

Ans : **SQP 2013**

The energy from the sun reaches the food chain through the primary producers (plants). This energy is passed on through successive trophic levels in the food chain. The energy transfer in the food chain follows the 10 percent law where in only 10% of the energy is transferred from one trophic level to the next successively. So the movement of energy is only in one direction from lower to higher trophic level.

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154. Sometimes due to biotic/abiotic factor the community remains in a particular seral stage (Pre climax) without reaching the climax. Do you agree with this statement. If, yes give a suitable example.

Ans : **DELHI 2010**

It is true that any change in the abiotic/biotic factor will arrest a particular seral stage leading to a pre-climax condition before the climax stage is achieved. This can happen in cases of forests fires, landslides, changes in soil characteristics, increase in herbivore population leading to overgrazing, e.g., maintenance of grasslands, teak forest, servforest etc.

155. What is an incomplete ecosystem? Explain with the help of a suitable example.

Ans : **OD 2024, 2006**

An ecosystem is a functional unit with biotic and abiotic factors interacting with one another resulting in a physical structure. Absence of any component will make an ecosystem incomplete as it will hinder the functioning of the ecosystem. Example of such an ecosystem can be a fish tank or deep aphotic zone of the oceans where producers are absent.

156. What are the shortcomings of ecological pyramids in the study of ecosystem?

Ans : **SQP 2005**

The ecological pyramid assumes a simple food chain and does not accommodate food webs. Thereby, it does not take into account the fact that species may belong to two or more trophic levels at a time. Also, saprophytes despite their vital role in ecosystem are given no place in the ecological pyramids.

157. The rate of decomposition of detritus is affected by the abiotic factors like availability of oxygen, pH of the soil substratum, temperature etc. Discuss.

Ans : **FOREIGN 2020**

The composition of detritus is due to activities of microorganisms. The rate of growth of microbes is affected by temperature. The pH of subtratum affects the composition of microbes (acidophiles/ basophiles) which degrade the dead organic

matter. If oxygen is present, aerobic degradation occurs. In the absence of oxygen anaerobiosis sets in and there will be incomplete degradation. Also, the degradation is due to activity of exo enzymes secreted by the microbes and the activity of enzyme is affected by factors such as temperature etc.

158. How is net primary productivity different from gross primary productivity?

Ans : **OD 2013**

Different between net primary productivity and gross primary productivity are as follows:

	Net Primary Productivity	**Gross Primary Productivity**
1.	It is the amount of organic matter stored by producers per unit time per unit area.	It is the amount of organic matter synthesised by producers per unit time per unit area.
2.	Net primary productivity is equal to organic matter synthesised by photosynthesis minus utilisation in respiration and other losses.	Gross primary productivity is equal to rate of increase in body weight of producers plus loss suffered through respiration and damages.
3.	It depends upon gross primary productivity as well as amount of consumption of photosynthates.	It depends upon photosynthetic efficiency of producers, availability of solar energy as well as organic nutrients.

159. How does a detritivore differ from a decomposer? Explain with an example each.

Ans : **COMP 2010**

Differences between detritivores and decomposers are as follows:

	Detritivores	**Decomposers**
1.	They are animals which feed on detritus.	They are micro-organisms which obtain nourishment from organic remains.
2.	Detritivores ingest the organic matter.	They decompose the organic matter be secreting digestive enzymes over it.
3.	Ecologically they cause pulverisation or fragmentation of detritus. E.g. Earthworm.	Ecologically they cause humification and mineralisation of organic matter. E.g., Pseudomonas.

160. How is detritus decomposed step-by-step by different agents and made available as nutrients to the plants? Explain.

Ans : **DELHI 2013**

Detritus (dead remains of plants and animals) gets decomposed and is made available as nutrients to plants by the process of decomposition. The steps in the process of decomposition are fragmentation, leaching, cataboslim, hunification and mineralisation.

1. **Fragmentation of Detritus :** Detritivores (e.g., earthworm) breakdown detritus into small particles.
2. **Catabolism :** Bacterial and fungal enzymes degrade detritus into simpler inorganic substances.
3. **Leaching :** Water soluble inorganic nutrients go down into the deeper layers of soil and get precipitated as unavailable salts.
4. **Humification :** It is the formation of humus from detritus or organic remains. Humus is dark coloured amorphous substance rich in lignin and cellulose. It is highly resistant to microbial action and undergoes decomposition at an extremely slow rate. It is colloidal in nature, a reservoir of nutrients and helpful in maintenance of soil moisture as well as aeration.
5. **Mineralisation :** It is the release of inorganic substances by the degradation of humus with the help of microbes.

161. Describe the events during humification and mineralisation during decomposition in the soil.

Ans : **SQP 2011**

(a) **Humification :** It is the formation of humus from detritus or organic remains. Humus is dark coloured amorphous substance rich in lignin and cellulose. It is highly resistant to microbial action and undergoes decomposition at an extremely slow rate. It is colloidal in nature, a reservoir of nutrients and helpful in maintenance of soil moisture as well as aeration.

(b) **Mineralisation :** It is the release of inorganic substances by the degradation of humus with the help of microbes.

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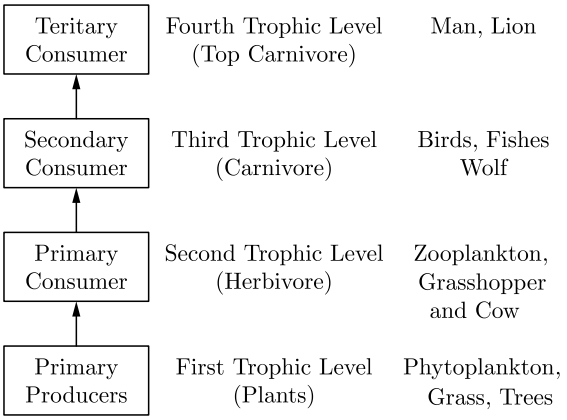
Ans : SQP 2011



130. Explain the terms (1) standing crop (2) biomass and (3) standing sate.

Ans : DELHI 2018

1. **Standing Crop :** Each trophic level has a certain mass/amount of living material at a particular time called as the **standing crop**.
2. **Biomass :** The standing crop is measured as **mass of living organisms** (biomass) or the **number in a unit area**. The biomass of a species is expressed in terms of total fresh or dry weight. Measurement of biomass in terms of dry weight is more accurate as moisture content of biomass varies greatly.
3. **Standing State :** Organisms need a constant supply of nutrients to grow, reproduce and regulate various body functions. The total amount of inorganic nutrients such as, carbon, nitrogen, phosphorus, calcium etc. present in the soil at any given time, is referred to as the **standing state**. It varies in different kinds of ecosystems and also on a seasonal basis.

131. Differentiate between Gaseous cycles and Sedimentary cycles.

Ans : SQP 2016

The difference between Gaseous cycles and Sedimentary cycles are as follows :

	Gaseous Cycles	**Sedimentary Cycles**
1.	Refer to gases such as (CO_2, N_2, O_2).	Refer to minerals such as (Ca, P, S, K, Mg).
2.	Reservoir pool in air or water.	Reservoir pool in rocks (lithosphere).
3.	Occur quickly and take less time to complete.	Occur very slowly and take a long time to complete.
4.	Are relatively perfect systems as the elements remain uniformly in circulation.	Are less perfect systems as the elements get locked in reservoir pool for long periods.

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132. Differentiate between autotrophs and Heterotrophs.

Ans : FOREIGN 2016

The difference between autotrophs and Heterotrophs are as follows :

	Autotrophs	**Heterotrophs**
1.	Can prepare their own organic nutrients themselves.	Cannot prepare organic nutrients themselves.
2.	Obtain energy from sunlight or exergonic chemical reactions.	Obtain energy from organic nutrients.
3.	Usually release O_2 to the environment.	Release CO_2 to the environment.
4.	Get inorganic materials from outside.	Get both organic and inorganic materials from outside.
5.	Include plants, some protists and certain bacteria.	Include animals, many protists and bacteria and fungi of decay.
6.	Two types: photoautotrophs and chemoautotrophs.	Two types: phagotrophs and saprotrophs.
7.	They are producer organisms.	They are consumer or reducer organisms.

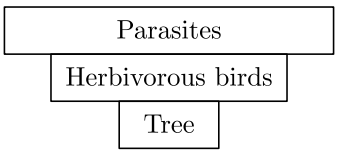
133. What are special consumers? Give a brief account.

Ans : DELHI 2017

Special consumers are house organisms which have special mode of food intake. These may include parasites, double consumers both producers and consumers and scavengers.

1. **Parasites :** Organisms like bacteria, protists and animals may be considered as secondary consumers or some higher order consumers.

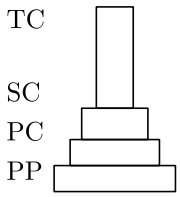
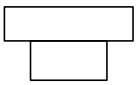
number of organisms gradually shows an increase, making the pyramid inverted in shape.



167. Differentiate between two different types of pyramids of biomass with the help of one example of each.

Ans : **OD 2012**

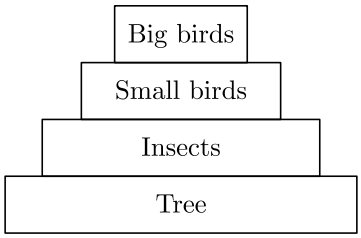
Pyramid of biomass is a graphic representation of biomass present sequence-wise per unit area of different trophic levels with producers at the base and top carnivores at the tip. Pyramid of biomass may be upright or inverted.

	Upright Pyramid of Biomass	**Inverted Pyramid of Biomass**
1.	The biomass of producers is more than that of consumers.	The biomass of producers is less than that of consumers.
2.	Pyramid of biomass in grassland is always upright.  Upright pyramid of biomass	Pyramid of biomass in aquatic ecosystem is always inverted.  Inverted pyramid of biomass

168. Differentiate giving reason, between the pyramid of biomass of the above situation and the pyramid of numbers that you have drawn.

Ans : **COMP 2005**

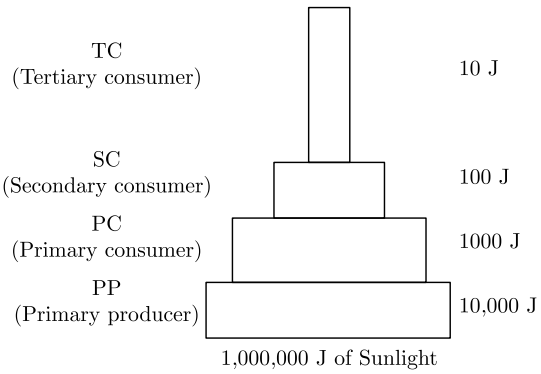
Pyramid of biomass in the above situation will be upright as tree has the maximum biomass which reduces with successive trophic levels resulting in an upright pyramid whereas the pyramid of number in above case is spindle-shaped where producers which are mainly large sized trees are lesser in number and form the base of the pyramid. The insects are more in number than producers. Then there is gradual decrease in the number of successive carnivores, thus making the pyramid upright again. This results in spindle shaped pyramid as shown here:



169. Construct an ideal pyramid of energy when 1,000,000 joules of sunlight is available. Label all its trophic levels.

Ans : **FOREIGN 2013**

An ideal pyramid of energy with primary producers storing only 1% of solar energy as NPP is shown below:



170. Explain the significance of ecological pyramid with the help of an example.

Ans : **DELHI 2015**

An ecological pyramid is a graphic representation of an ecological parameter present in various trophic levels of a food chain with producers forming the base and top carnivores the tip. It expresses the relationship between the organisms at different trophic levels with reference to their number, energy and biomass. For example, pyramid of numbers is a graphic representation of the number of individuals per unit area of various trophic levels stepwise with producers at the base and top carnivores at the tip.

Pyramid of biomass shows the total amount of living matter (fresh weight or dry weight) present in each level and pyramid of energy is a graphic representation of amount of energy trapped per unit time and area in different trophic levels of a food chain with producers forming the base and top carnivores the tip.

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171. Why are the pyramids referred to as 'upright' or 'inverted'? Explain.

Ans : SQP 2020

Usually producers exceed higher trophic levels in biomass, number and energy. Hence a structure with broad base, gradually tapering body and narrow apex is obtained which resembles an upright pyramid.

In some cases e.g., for biomass in pond ecosystem, for number of individuals in a parasitic food chain the relationship changes. Here producers show the least biomass or number and the top consumers show the highest biomass or number. As a result a structure resembling an 'inverted' pyramid is obtained.

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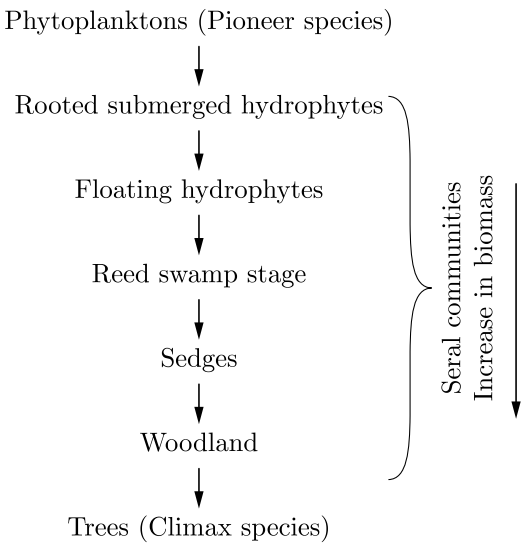
172. Name the pioneer and the climax species in a water body. Mention the changes observed in the biomass and the biodiversity of the successive serial communities developing in the water body.

Ans : COMP 2016

In a hydrosere (succession in a water body) pioneer species include phytoplanktons and climax species include large tress. There is a gradual increase observed in the biomass and the level of biodiversity in the successive seral communities. Sequence of communities during hydrosere is shown below:



173. Differentiate between primary and secondary succession. Provide one example of each.

Ans : FOREIGN 2016

Differences between primary succession and secondary succession are as follows:

	Primary Succession	**Secondary Succession**
1.	It occurs in an area which has been bare from the beginning.	It occurs in an area which has been denuded recently.
2.	Soil is absent at the time of beginning of primary succession.	Soil is present in the area where secondary succesion begins.
3.	There is no humus in the beginning.	Humus is present from the very beginning.
4.	Reproductive structures of any previous community are absent.	Reproductive structures of the previous occupants are present in the area.
5.	Pioneer community comes from outside.	Pioneer community develops partly from previous occupants and partly from migrants.
6.	In the beginning the environment is very hostile.	The environment is favourable from the beginning.
7.	Seral communities are many.	Seral communities are a few.
8.	Primary succession takes a long time for completion, 1000 years or more.	Secondary succession takes lesser time for completion, 50-200 years.
9.	Example: Succession on a newly exposed sea floor.	Example: Succession on an area destroyed by flood.

174. Explain succession of plants in xerophytic habitat until it reaches climax community.

Ans : OD 2005

Xerarch succession occurs on bare rocks. The habital lacks soil, has intense light, fluctuations of temperatures and winds. The species that invade a bare area are called pioneer species. In primary succession on rocks lichens are usually the pioneer species which are able to secrete

acids to dissolve rocks, helping in weathering and soil formation. These pave way for some small plants like bryophytes, which are able to take hold in the small amount of soil. They are, with time, succeeded by herbs stage, then shrub stage and then bigger plants, and ultimately a stable climax community i.e., forest is formed. The climax community remains stable as long as the environment remains unchanged. With time, the xerophytic habitat gets converted into a mesophytic one.
Lichens (Pioneer community) → Bryophytes → Herbaceous plants → Shrubs → Trees (Climax community).

175. Explain the differences and the similarities between hydrach and xerach succession of plants.
Ans : **DELHI 2011**

Differences between hydrarch and xerarch succession are as follows:

	Xerarch Succession	**Hydrarch Succession**
1.	It begins with lichens or blue green algae.	It begins with phytoplankons.
2.	Initial succession is a slow process.	Initial succession is quite fast.
3.	Succession is seen all over the area.	Succession is observed in area where water is not very deep.
4.	The whole of the area is involved in formation of climax community.	Climax community develop on the edge only.
5.	Succession converts xeric environment into mesic environment.	It converts aquatic environment into mesic environment.
6.	It reduces bare land area and converts it into fertile forested area.	It fills up water body and changes it into forested land.

Similarities between hydrarch and xerarch succession are as follows:

1. Both start with pioneer communities and end in a climax one.
2. Both end in a mesic environment.
3. Both lead from low to high diversity of life.
4. Both result in gradual increase of biomass.
5. Both involve considerable niche specialisation.

176. How does phosphorus cycle differ from carbon cycle?
Ans : **FOREIGN 2019**

Differences between carbon cycle and phosphorus cycle are as follows:

	Carbon Cycle	**Phosphorus Cycle**
1.	Its major component is gaseous.	Its major component is non-gaseous.
2.	There is respiratory release of carbon as CO_2.	There is no respiratory release of phosphere.
3.	Its cycling pool is present in hydrosphere and atmosphere.	Its cycling pool is lithosphere.
4.	Its reservoir pool is atmosphere.	Its reservoir pool is lithosphere.
5.	Atmospheric input of carbon through rainfall is appreciable.	It is negligible.
6.	There is exchange of carbon between organisms and environment.	There is no such exchange.

177. Global carbon is fixed in the biosphere through photosynthesis. Explain any two ways by which carbon is returned to the atmosphere.
Ans : **SQP 2008**

The two ways by which carbon is returned to the atmosphere are:

1. By respiration of all living organisms: During respiration, all living organisms release carbon dioxide which returns to atmosphere thereby replenishing its amount in the atmosphere.
2. By burning of fossil fuels: Fossil fuels like coal, petroleum and natural gas are rich source of carbon. On burning, they release carbon in the form of carbon dioxide back to the atmosphere.

178. Draw a simplified model of phosphorus cycling in terrestrial ecosystems.
Ans : **COMP 2016**

A simplified model of phosphorus cycle is as follows:

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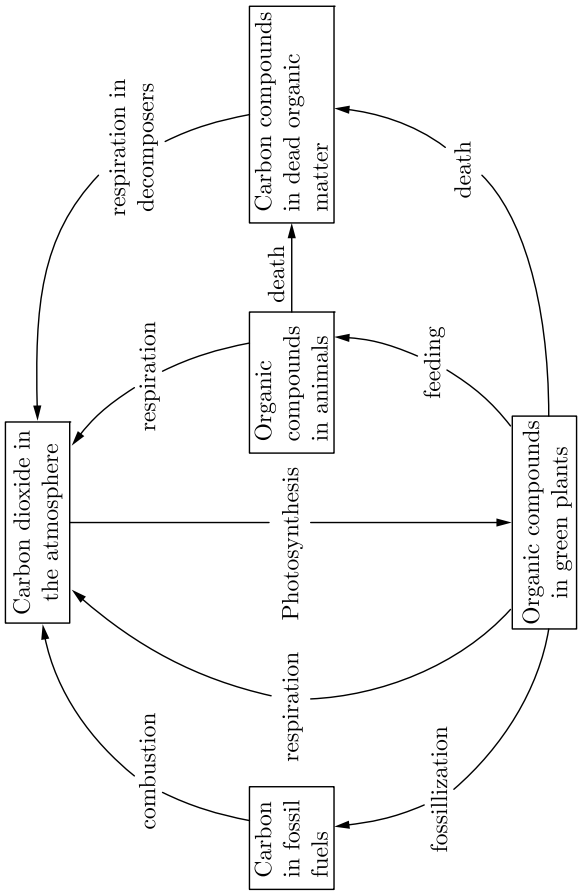
is then returned to the atmosphere as carbon dioxide. In some circumstances the process of decomposition is prevented. The decomposed plants and animals may then be available as fossil fuel in the future for combustion.



190. What are inter-specific interactions? Explain important ones with suitable examples.

Ans : **OD 2016**

Interactions among the different species of a community or ecosystem are known as inter-specific interactions. These interactions may be (1) negative (2) positive or (3) neutral. Negative interactions are not useful for both interacting species. Positive, however are useful to interacting species and neutral ones are neither harmful nor useful. There is no effect on the growth of populations in neutral interactions.

Mutualism : In this type of interaction both species are benefited from one another. They cannot live without one another. It is a functional association and not merely living together. Mutualism may be obligate or facultative. In obligate type their is complete interdependence. One species cannot live without the other, but in facultative one species can survive without the other. For example Mycorrhizae, Lichens.

Commensalism : It is a relationship between two different species in which one is benefited while the other may or may not. But at the same time it is not affected adversely too. This type of relationship is available both in plants as well as animals e.g. Epiphytic growth of an orchid on the tree. Various types of climbers that do not harm the trees.

Parasitism : It is a negative association in which one species is benefited and the other is harmed. The benefited one is parasite that lives on the host that is harmed. Parasites may also be obligate or facultative. Obligate ones are host specific whereas facultative ones are not host specific. Plants and animals both have parasites. Cuscuta is a parasitic plant host plant. Human louse is ectoparasite on human body. Many bacteria and fungi are parasitic on plants and animals including human beings.

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191. Define community, give its major characteristics.

Ans : **DELHI 2012**

Individuals of different species together at a particular time in a specific area constitute a community. There are so many communities in nature.

Characteristics of Communities : Some specific ecological characteristics of a community determine their composition and differentiate one community from another. Some major characteristics of a community are as under.

1. **Species Composition :** Different type of organisms that is plants, animals and micro-organisms are the members of a community. They show the species composition of a community. The species composition is variable in different communities. There may be even seasonal variations of species in the same community.
2. **Dominance :** Some species are more in number in the community. Their abundance influences and diminates the other species. The animal distribution of a community is also dependent upon dominant species.
3. **Species Diversity :** Different types of species present in the community makes its basic characteristic. However it is difficult to know the number of all species e.g. species of insects etc. in the community. Many species are quite rare but cannot be ignored. Species density is measured with the help of common index proposed by Shannon, Coral reef and tropical rain forests communities have very high species diversity.

called El Nino effects which may create severe environmental issues and disturb the ecological balance.

182. Biodiversity must be conserved as it plays an important role in many ecosystem services that nature provides. Explain any two services of the ecosystem.

Ans : FOREIGN 2010

For best services the ecosystem must be healthy. There are several advantages for keeping ecosystem healthy. Ecosystem services provided by nature are as follows:

1. Soil formation and soil protection are the major ecosystem services accounting for nearly 50% of their total worth. Plant cover protects the soil form drastic changes in temperature. There is little wind or water erosion as soil particles are not exposed to them. The soil remains spongy and fertile. There are no landslides and no floods.
2. Plant litter and humus prevent run off water, hold water like sponge and allow percolation of water. A lot of water is held in the soil which slowly passes towards perched water table. It comes out as springs. They are source of perennial freshwater which is quite pure.

183. Write any two limitations of ecological pyramids.

Ans : COMP 2012

The limitations of ecological pyramids are:

(a) Ecological pyramids assume that food chains are simple. Simple food chains do not occur in nature. Instead, food webs are present.

(b) A single species may operate at two or more trophic levels. Ecological pyramids have no method of accomodating such cases.

(c) Ecological pyramids have no place for detrivores and decomposers though they play a vital role in ecosystem.

184. Why is the rate of secondary succession faster than that or primary succession?

Ans : OD 2016

Rate of secondary succession is faster as a secondarily barred area has a built in soil organic matter. It is biologically fertile so succession is completed quickly. Underground parts, like vegetative propagules and seeds etc., of plants and invaders quickly give rise to a new community as soon as conditions become favourable. It has few seral changes and quickly gives rise to climax community.

LONG ANSWER QUESTIONS

185. What do you understand by an ecosystem? Describe the structure and components of an ecosystem.

Or

Describe all the factors of an ecosystem.

Ans : OD 2015, SQP 2010

An ecosystem can be defined as the interactions of organisms with each other and with their physical environment. The term 'Ecosystem' was coined by AG tansley (1935). It is also called as biocoenosis (Mobius, 1877), microcosm (Forbes, 1887) or biogeocoenosis.

Types of Ecosystem : On the basis of nature and origin, ecosystem can be divided into two main types.

1. **Natural Ecosystem :** These are naturally developed self regulating ecosystem without any major interference by man. It can be of two types
   (a) **Terrestrial Ecosystem :** Eg. forest, grassland etc.
   (b) **Aquatic Ecosystem :** Eg. ponds, lakes etc.
2. **Artificial Ecosystem :** These are man made ecosystems eg. agricultural fields, orchards, etc.

Structure of Ecosystem : There are two main components of ecosystem, Abiotic (non living) and biotic (living).

1. **Abiotic Components (Non Living) :** It is physical or non-living part of ecosystem. It can be grouped into following three categories.
   (a) **Physical Factors :** Sunlight, temperature, rainfall, humidity and pressure. They sustain and limit the growth of organisms in an ecosystem.
   (b) **Inorganic Substances :** Carbon dioxide, nitrogen, oxygen, phosphorus, sulphur, water, rock, soil and other minerals.
   (c) **Organic Compounds :** Carbohydrates, proteins, lipids and humic substances. They are the building blocks of living systems and therefore, make a link between the biotic and abiotic components.
2. **Biotic Components (Living) :** It includes living components of ecosystem. It can be grouped in three categories.
   (a) **Producers :** The green plants manufacture food for the entire ecosystem through the process of photosynthesis. Green plants are called autotrophs, as they absorb water and nutrients from the soil, carbon

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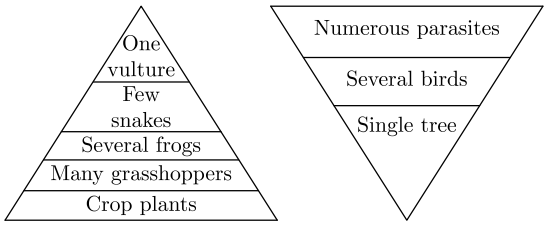
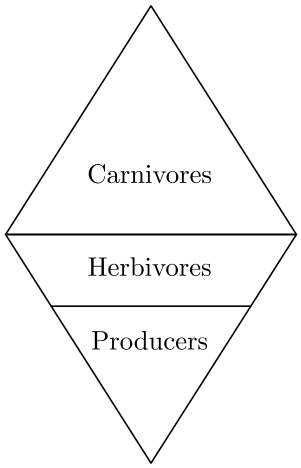
parasitic ecosystem. There one single bee (primary producer) has got large number of birds on it (primary consumers) which have large number of insects outside their body (secondary consumer).

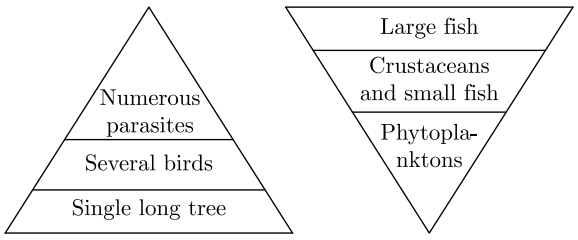


(a) Upright (b) Inverted

Another exception of pyramid of number is spindle shaped pyramid, where the number of producers is lesser but support a greater number of herbivores which in turn support a fiever number of carnivores eg. forest ecosystem, ecosystem.



2. **Pyramid of Biomass :** Biomass is the amount of living matter present in an ecosystem. The pyramid of biomass is upright in case of a tree, which supports a large number of birds and inverted in aquatic ecosystem (pond) because in it, producers are microorganisms and their biomass is very less



(a) Upright (b) Inverted

Fish occupy more than one tropic level in a pond ecosystem.

3. **Pyramid of Energy :** It represents the total amount of energy utilized by different trophic level organisms in unit area over a period of time. It is always upright because there is always a gradual decrease in energy at successive trophic levels.

CASE BASED QUESTIONS

198. Decomposition is the process of breaking down of complex organic inerganc substances such as water, CO_2, nutrients by decomposer set.

(i) How decries is known as the raw material for decomposition ?

(ii) List any steps of decomposition.

(iii) Which factors affects decomposition. Name any.

Ans : **COMP 2015**

(i) Detritus is the raw material for decomposition. It includes dead remains of plants (leaves, bark and flowers) and animals, including fecal matter.

(ii) (a) Fragmentation
(b) Leaching
(c) Catabolism
(d) Humification

(iii) (a) Chemical composition of detritus
(b) Climatic factors.

199. Ecological pyramid is the graphical representation of an ecological parameter (number, biomass, energy) sequence wise in various trophic levels of a food chain.

(i) At what level of ecological pyramid produces are present ?

(ii) List the different types of pyramids known to us.

(iii) A pyramid of number in case of a big tree is generally inverted. Why ?

Ans : **OD 2007**

(i) producers are always found at the base of the ecological pyramid.

(ii) Pyramids can be either upright, inverted, or spindle shaped.

(iii) This is because the number of insect feeding on that tree generally exceeds in number.

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ii. **Top Consumers :** These organisms which feed upon primary, secondary and tertiary consumers, e.g. waste snake, water birds etc.

3. **Decomposers :** These include heterotrophic microorganisms such as bacteria, fungi, which break down the organic complex food from dead producers and consumers into simple inorganic compounds and make them available to the producers.

188. What is food chain? Discuss the food chain in forest ecosystem.

Ans : **OD 2011**

The transfer of food energy from the producers, through a series of organisms (herbivores to carnivores to decomposers) with repeated eating and being eaten, is known as food chain.

The transfer of energy that takes place in a series of steps or levels. Plants and other producers occupy the first level known as primary consumers. Herbivores which feed on plants occupy the second tropic level and Carnivores that eat herbivores are at third topic level. The energy is transferred continuously from lower to higher level. The availability of energy decreases with successive higher tropic levels. Energy is dissipated to the environment in the form of heat and respiration 10 to 50 per cent of stored energy level is transferred and a perfect harmony is achieved between the cycles and the inflow of energy establishes a dynamic and fluctuating equilibrium in the ecosystem. This is known as "ecological balance.

Types of Food Chain :

In nature, basically two types of food chains are recognised- grazing food chain and detritus food chain.

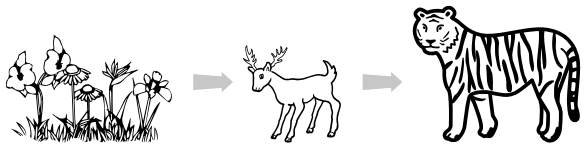
1. **Grazing Food Chain :** This type of food chain starts from the living green plants goes to grazing herbivores, and on to carnivores. Ecosystems with such type of food chain are directly dependent on an influx of solar radiation. This type of chain thus depends on autotrophic energy capture and the movement of this captured energy to herbivores. Most of the ecosystem in nature follow this type of food chain.

It can be further divided into two types:

(a) **Predator Food Chain :** In it, the sequence of organisms are generally from small to big.

(b) **Parasitic Food Chain :** Here, organisms tend to decrease in size as one goes higher up the food chain.

In a forest ecosystem, grass is eaten by a deer, which in turn is eaten by a tiger. The grass, deer and tiger from a food chain. In this food chain, energy flows from the grass (producer) to the deer (primary consumer) to the tiger (secondary consumer).



2. **Detritus Food Chain :** This type of food chain goes from dead organic matter into micro-organisms and then to organisms feeding on detritus (detrivores) and their predators. Such type of food chain operates in the decomposing accumulated litter in a temperate forest.

189. Explain the carbon cycle in an ecosystem.

Ans : **OD 2010**

The cyclic flow of carbon between non-living environment and living organisms of biosphere is called carbon cycle.

Carbon is found in many forms on earth. In its elemental forms, it occurs as diamond and graphite. In combined form carbon is found as carbon dioxide which is the main reservoir of carbon in the atmosphere. Carbon is also found as carbonate and hydrogen carbonate salts in limestone and other hocks and fossil fuels (coal, petroleum, natural gas).

Carbon is also an essential component of all the organic compounds like carbohydrates, fats, proteins, vitamins, nucleic acids, enzymes and hormones present in living organisms.

The basic outline of carbon cycle is as follows.

1. Carbon enters the atmosphere as carbon dioxide from respiration and combustion.
2. Carbon dioxide is absorbed by producers (life forms that make their own food e.g. plants) to make carbohydrates in photosynthesis. These producers then put off oxygen.
3. Animals feed on the plants. Thus passing the carbon compounds along the food chain. Most of the carbon these animals consume however is exhaled as carbon dioxide. This is through the process of respiration. The animals and plants then eventually die.
4. The dead organisms (dead animals and plants) are eaten by decomposers in the ground. The carbon that was in their bodies

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dioxide from the air, and capture solar energy for this process.

(b) **Consumers :** They are called heterotrophs and they consume food synthesized by the autotrophs. Based on food preferences they can be grouped into three broad categories. Herbivores (e.g. cow, deer and rabbit etc.)feed directly on plants, carnivores are animals which eat other animals (eg. Lion, cat, dog etc.) omnivores organisms feeding upon both plants and animals e.g. human, pigs and sparrow.

(c) **Decomposers :** Also called saprotrophs. These are mostly bacteria and fungi that feed on dead decomposed and the dead organic matter of plants and animals by secreting enzyme outside their body on the decaying matter. They play a very important role in recycling of nutrients. They are also called detrivores or detritus feeders.

186. What is food web? Explain it with the help of suitable examples.

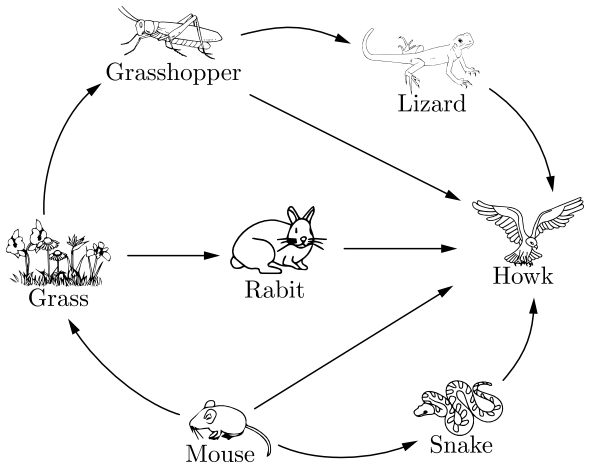
Ans : **OD 2017**

The network of several interconnected food chains is called a food web. Various food chains in an ecosystem do not operate in isolation. They operate in the form of network of food chains. One organism may obtain its food from different sources and in turn may be eaten up by different types of organisms.

This means, a food web has various alternative pathways for the flow of energy. The complexity of food web can be expressed by a measure called the connectance of the food web.

Connectance

$$= \frac{\text{Actual number of interspecific interactions}}{\text{Potential number of interspecific interactions}}$$



187. What is pond? Describe the components of a pond ecosystem.

Ans : **OD 2013**

The pond is a small body of standing water ponds are aquatic freshwater ecosystems that form in depressions in the earth's surface. The pond ecosystem has complex interactions between its abiotic components. The Abiotic components of pond ecosystem are as follows:

1. **Environmental Factors :** It includes light, temperature, water etc.
2. **Organic Components :** These are living components of ecosystem. It consist of carbohydrates, proteins, amino acids, fats, nucleic acids.
3. **Inorganic Components :** These are non living components of ecosystem. It includes O_2, CO_2, N_2, nitrates, phosphates, carbonates, etc.

Biotic components of pond ecosystem are:

1. **Producers :** The producers are the aquatic green plants, which may be divided into two groups.
   (a) **Microphytes (Phytoplanktons) :** They are microscopic autotrophs, which fix solar energy, e.g. spirogyra, Zygnema, Volvox, Oedogonium.
   (b) **Macrophytes :** They are larger plant, which manufacture complex food. They are following types:
      i. **Sumberged Plants :** These plants remain sink in water. e.g. Hydrilla and Utricularia.
      ii. **Floating Plants :** These plants float freely on water surface e.g. Pistia, Nymphea and Azolla.
      iii. **Immerged Plants :** These are rooted plants that float over water. Ranunculus, Sagittaria and Typha.
2. **Consumers :** These are heterotrophic organisms, which consume producers as food. They are of following types.
   (a) **Primary Consumers :** These are herbivorous animals that eat autotrophic organisms.
   (b) **Secondary Consumers :** These are primary carnivores, which consume herbivorous animals for food, e.g. insects, fishes, frogs, crab, etc.
      i. **Tertiary Consumers :** These feed upon plants or animals (secondary consumer) therefore are called omnivores, e.g. large fishes and frogs.

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4. **Keystone Species :** A keystone species is that whose activities determine the structure of a community. Although such species are relatively rare yet their significance is high.
5. **Edge Effect :** The increased density and variety of some species at the border of community is called edge effect. The species present in this area i.e. junction between the communities are known as edge species.
6. **Stability :** Stability may be (a) local or (b) global. It is a dynamic concept. Although diversity of species decrease the stability of a community. Yet diversity and stability are related in natural communities as they both are the results of evolution. Pollution created by human populations have disturbed many natural communities.
7. **Physiognomy :** It is the external appearance of a community. This appearance is based on many qualitative characteristics such as dominant species, density, life form cover stratification and species dissociation. Appearance of a community can be identified on the basis of its physiognomy. However some communities may have similar physiognomy.

192. Distinguish between

1. Grazing food chain and detritus food chain
2. Production and decomposition
3. Upright and inverted pyramid
4. Food chain and food web
5. Litter and detritus
6. Primary and secondary productivity

Ans : **FOREIGN 2016**

1. **Grazing Food Chain** (GFC) is the food chain which start with the producers or autotrophsthe organisms which can prepare their own with the process of photosynthesis while the **detritus food chain** (GFC) begins with the dead organic matter. It is made-up of **decomposers** which are heterotroph organisms mainly fungi and bacteria. As they meet their nutrient requirements by degrading dead organic matter or detritus, they are termed as **saprotrophs**.
2. **Prodcution and Decomposition :**

   Production : It is the synthesis of organic matter/food from inorganic matter i.e., CO_2 and H_2O in the presence of sunlight by the chlorophyll containing green cells of the plants.

   Decomposition : It is the process of degrading the dead complex organic matter into the simple, soluble diffusible inorganic substances by the secretion of digestive enzymes by decomposer. These substances are subsequently absorbed by them.
3. **Upright and Inverted Pyramids :**

   Upright Pyramid : In a terrestrial habitat, when the number of organisms or their biomass is maximum at the level of producers and there is a progressive decrease in the number or biomass from lower to the higher trophic levels in a food chain we get an upright pyramid, e.g. Pyramid of number in a grassland ecosystem.

   Inverted Pyramid : When the number of individuals or their biomass at the producer level is minimum and it increases progressively at each trophic level in a food chain, we get inverted pyramid, e.g., small standing crop of phytoplankton supports large standing crop of zooplankton. A single large sized tree provides nourishment to several herbivores (birds), which may support a still larger number of ectoparasites.
4. **Food Chain and Food Web :**

   Food Chain is the sequence of populations or organisms of an ecosystem through which the food and its contained energy passes with each member becoming the food of a later member of the sequence. Food chain is always straight and proceeds in a progressive straight line.

   Food-Web is a network of food chains which become interconnected at various trophic levels so as to form a number of feeding connections amongst the different organisms of a biotic community. It increases the stability of an ecosystem.
5. **Litter and Detritus :**

   Litter is the fallen above ground detritus composed of dead organic remains of plants-leaves, bark, twigs flowers etc. and the dead remains of animals their faecal matter that fall on surface of earth in terrestrial ecosystem. **Detritus** is the decaying, broken down organic matter from the activities by decomposers. **Detritus** is the source of food for detrivores which can themselves be eaten by carnivores in a detritus food chain. Detritus may be (a) dead organic remains above the ground (b) dead organic remains below the ground.

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6. **Primary and Secondary Productivity :**

Primary Productivity is the rate of production of biomass or organic matter per unit area over a time period by the producers in an ecosystem while **Secondary Productivity** refers to the rate of production of biomass or organic matter (flesh) over a time period by the consumer.

193. With suitable examples, explain the energy flow through different trophic levels. What does each bar in this pyramid represent?

Ans : **FOREIGN 2008**

Ecosystem requires a constant input of energy. Energy flow in the ecosystem is very important as it is the basis of life. Food provides both matter and energy. Flow of energy determines the diversity of organisms. It also determines the developmental and functional status of the ecosystem. Energy flow in an ecosystem is always unidirectional or one way, i.e., solar radiations → producers → herbivores → carnivores. It cannot pass in the reverse direction as there is always decrease in the content and flow of energy with the rise in trophic level. A part of energy captured by producers (gross primary productivity) is used for maintenance (lost in respiration) and as food to herbivores.

Only 10% of the gross productivity of producers is entrapped by herbivores for their body building. Herbivores are eaten by primary carnivores. Herbivores not preyed by carnivores die a natural death and energy trapped in their body is transferred to decomposers. Only 10% of the herbivores productivity is utilised for raising productivity of primary carnivores. The rest is consumed in ingestion, respiration, maintenance of body heat and other activities. Higher carnivores similarly are able to retain only 10% of energy present in primary carnivores.

Producer →	Herbivore →	CarnivoreI →	CarnivoreII
biomass	biomass	biomass	biomass
1000 K cal	100 K cal	10 K cal	1 Kcal

Therefore, the pyramid of energy is always upright with base representing the producers and apex occupied by top carnivores. Each bar of the pyramid represents one trophic level.

194. Explain how a hydrarch succession progresses from hydric to mesic condition and forms a stable climax community.

Ans : **SQP 2009**

Hydrarch succession refers to series of biotic communities that develop one after the other in a newly formed pond or lake. Various successive stages of hydrosere are:

(a) **Plankton Stage :** It is the pioneer stage of hydrosere. The autotrophic organisms called phytoplanktons, (e.g., diatoms), zooplanktons (which feed on phytoplankton) and decomposers constitute this stage. Death and decomposition of plankton produce organic matter which mixes up with clay and settles at the bottom to form soft mud favourable for growth of next seral stage.

(b) **Submerged Stage :** The bottom lined by soft mud having organic mater is favourable for growth of submerged plants like Hydrilla, Potamogeton and Najas. They are rooted in the mud and form dense growth. On decaying the older plants and buried parts of other plants form humus which enriches the newly built up bottom and makes it favourable for growth of next stage.

(c) **Floating Stage :** Floating leaved anchored plants (e.g., Nymphaea, Nelumbo, etc.) appear when water becomes shallow. The plants make the water rich in mineral and organic matter. It becomes suitable for growth of free floating plants like Lemna, Spifodela etc. Rapid growth of floating stage further builds up bottom so that water becomes shallow.

(d) **Reed Swamp Stage :** Amphibious plants e.g., Phragmites, Typha etc. grow when the water body becomes shallow. Their tangled growth accumulates slit.

(e) **Sedge or Marsh Meadow Stage :** Reed swamp stage are invaded by Carex (Sedge), grasses like Themeda and Dichanthium and herbs like Campanula etc. The plants transpire rapidly and add abundant humus. Therefore, soil is build up for the next stage.

(f) **Woodland Stage :** Sedge meadow stage is invaded by some rhizome bearing plants which can tolerate bright sunlight as well as water logged conditions, e.g., Cornus (Bogwood) etc. They invite invasion by trees capable of bearing bright sunlight and water logging, e.g., Populus (Cottonwood), Alnus (Alder). They built up more soil.

(g) **Climax Forest :** New tress invade the area. These tress grow to greater heights with time a hydrophytic habital gets converted to mesophytic one and forms a stable community.

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195. Explain how xerarch succession progresses from xeric to mesic condition and forms stable climax community.

Ans : **COMP 2017**

Xerarch succession is the sequence of successional stages that occur on bare rocks. The various stages and their component plant species appearing on a rock are as follows:

1. **Pioneer Stage :** The first vegetation to occupy the rocky habitat is of crustose lichens, e.g., species of Rhizocarpon, Rhinodina and Lecanora. They produce some acids which bring about weathering of rocks which invites foliose lichen. The CO_2 released during the respiration of these lichens react with water and forms acid. Thus, the process of breaking up of rock becomes more rapid.
2. **Moss Stage :** The bryophytes and particularly the mosses develop and spread very rapidly on the rocks. They accumulate more soil and organic matter which makes the surface suitable for next stage.
3. **Herb Stage :** This stage is constituted by shallow rooted grasses as Eleusine, Poa, Aristida, etc. These accumulate more soil and more minerals.
4. **Shrub Stage :** Du to much accumulation of soil, the habitat becomes suitable for shrub vegetation. This habitat includes the species of Zizyphus, Caparis, etc. These, in turn, are finally replaced by tress, the climax community.
5. **Forest Stage :** Some xerophytic tree species invade the area. Further weathering of rocks and increasing humus content of the soil favour the arrival of more trees, and vegetation finally becomes mesophytic. Thus, there develops finally a forest community.

196. Discuss the role of healthy ecosystem services as a pre-requisite for a wide range of economic, environmental and aesthetic goods and services.

Ans : **COMP 2016**

The products of healthy ecosystem processes which have environmental, aesthetic and indirect economic value are named as ecosystem services. It includes:

1. **Soil :** Soil formation and soil protection are the major ecosystem services accounting for nearly 50% of their total worth, Plant cover protects the soil from drastic changes in temperature. There is little wind or water erosion as soil particles are not exposed to them. The soil remains porous and fertile. There are no landslides and floods.
2. **Perennial Water :** Plant litter and humus prevent run off of water, hold water like sponge and allow percolation of water. A lot of water is held in the soil which slowly passes towards perched water table and comes out as springs. They are a source of perennial fresh water which is quite pure.
3. **Air :** Plant cover of natural ecosystem absorb polluting gases, cause settling of suspended particulate matter, removes CO_2 and releases O_2. A purified air becomes available.
4. **Wetlands :** They protect the land from floods, remove sediments and other pollutants and recharge ground water.
5. **Climate :** There is increase in atmospheric humidity, good rainfall and moderating effect on climate.
6. Maintenance of biodiversity.
7. **Nutrient Cycling :** There is no depletion of nutrients but the same are repeatedly circulated and recirculated. It keeps the fertility of soil intact.
8. **Wildlife Habital :** They are habital of wildlife.
9. **Pollination :** Bees and other insects of natural ecosystems visit nearby farmlands and pollinate the crop plants.
10. **Home to Tribals :** A large number of tribals live in forests.
11. **Grazing Grounds:** They are grazing areas for numerous cattle.
12. **Other Values :** Natural ecosystems are a source of spiritual, cultural and aesthetic values.

197. Write about three ecological pyramids with examples.

Ans : **OD 2016**

Ecological Pyramids are the diagrammatic illustrations of connection between different trophic levels in terms of energy, biomass and number of an organism.

The concept of ecological pyramids was developed by Chales Elton (1927) therefore, they are also called as Eltonian pyramids.

There are three main types of ecological pyramids. These are as follows.

1. **Pyramid of Number :** This type of pyramid deals with the number of organisms in each trophic level. e.g. grassland and aquatic ecosystem. The pyramid of number is inverted in case of tree ecosystem. It is also called

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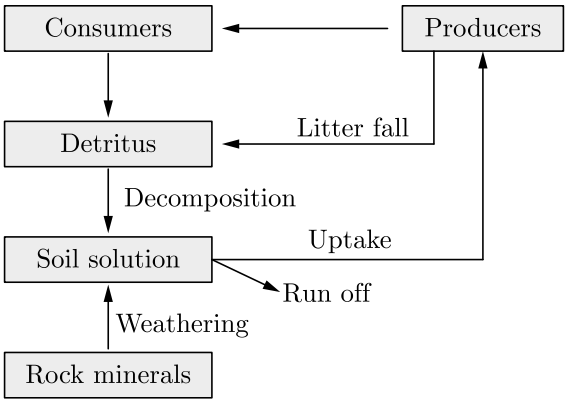


179. Write importance of such cycles in ecosystem.

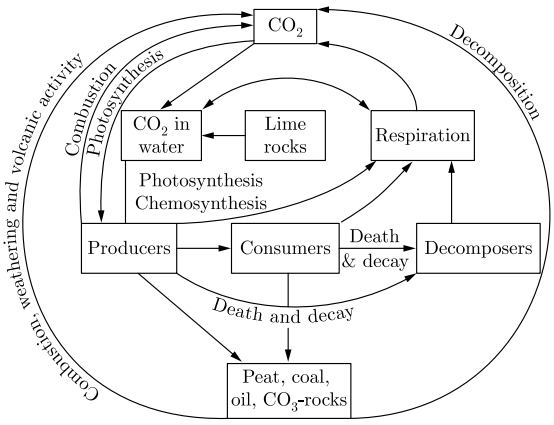
Ans : **OD 2007**

Nutrient cycling helps to maintain stability and enables proper functioning of an ecosystem. Such cycles help in circulation of nutrients between abiotic and biotic components of an ecosystem and thereby help in maintaining ecosystem and thereby help in maintaining ecosystem balance. Nutrient input in an ecosystem occurs through rain and dust fall, nitrogen fixation and weathering of rocks. Theses nutrient are taken up by plants and are passed on to different trophic levels of a food chain operating in an ecosystem. These nutrients are again made available to the lithosphere by death of living beings, followed by decomposition of the dead organic matter by microbes. The amount of nutrient uptake is equal to amount of nutrients recycled in a balanced ecosystem. Hence, nutrient cycles ensure proper and continuous supply of nutrients in an ecosystem.

180. Explain the carbon cycle with the help of a simplified model.

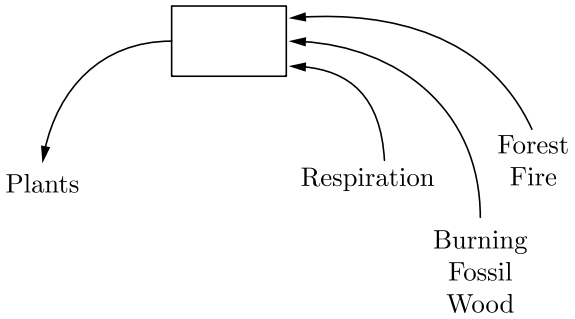
Ans : **DELHI 2009**

A simplified model of carbon cycle is as follows :



Carbon forms the backbone for complex organic molecules of protoplasm like carbohydrates, lipid, proteins etc. Main sources of carbon are air, water, fossil fuel and rocks. Carbon dioxide is added to the cycle pool of atmosphere by respiration, decomposition of organic waste, burning of fossil fuels, volanic eruption, etc. Carbon fixed by producers enters the food chain and hence passes to herbivores, carnivores, decomposers, etc. Natural exchange between lithosphere and hydrosphere or atmosphere is a very slow process. Major exchange in carbon cycle is between organisms (absorption by producers, released by all in respiration) and the atmosphere or hydrosphere. This cycling is a self-regulated feed back system but has recently been upset due to rapid deforestation and increasing combustion of fossil fuels.

181. 1. (a) Name the bio-geochemical (nutrient) cycle shown below.



(b) Name an activity of the living organisms not depicted in the cycle by which this nutrient is returned to the atmosphere.

2. How would the flow of the nutrient in the cycle be affected due to large scale deforestation? Explain giving reasons.

3. Describe the effect of an increased level of this nutrient in the atmosphere on our environment.

Ans : **SQP 2019**

1. (a) The bio-geochemical cycle shown in the figure is carbon cycle.
   (b) Decomposition by micro-organisms is not depicted in the given cycle.
2. Due to large scale deforestation, the level of carbon dioxide in the environment will be disturbed because plants are the major consumers which utilise carbon dioxide for photosynthesis. This would disturb the balance of oxygen and carbon dioxide in the atmosphere.
3. Increase in the level of carbon dioxide in atmosphere will result in greenhouse effect. This will lead to global warning (rise in earth's mean annual temperature). Rise in temperature will result in climatic changes

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CHAPTER 13

BIODIVERSITY AND ITS CONSERVATION

SUMMARY

1. CONCEPT OF BIODIVERSITY

The biodiversity is defined as the totality of genes, species and ecosystems of a region. This is not homogeneously distributed over time as well as space.

1.1 Levels of Biodiversity

Biodiversity includes three hierarchical levels ; species diversity, genetic and community unity as well as ecosystem diversity.

The three types of diversity are :
(a) genetic diversity
(b) species diversity
(c) ecological (ecosystem) diversity

There are three forms of diversity at **community** and **ecosystem level** : (a) alpha diversity, (b) beta diversity and (c) gamma diversity.

1.2 Biodiversity in India

India has 10 bio-geographical regions. There are 2 hot spots in India. India's Biodiversity :

Characteristics	**Explanation etc.**
Hot Spots	Two (2) western ghats and Eastern Himalayas
Heritage	Five (5) places attract tourists
Biosphere Reserves	Fourteen (14)
National Parks	Eighty nine (89)
Sanctuaries	Four hundred Ninety two (492)

1.3 Hot Spots

These are priority areas for conservation of the biodiversity. Twenty five terrestrial hot spots for conservation of biodiversity have been identified in the world. There are only 2 hot spots in India Hot spot concept was given by **N.Myers** (1988). They are rich in species (have richness of the species).

1.4 Criteria to Determine Hot Spots

1. The number of Endemic species,
2. The degree of threat (measured in terms of habitat loss).

1.5 Benefits of Biodiversity (Uses of Biodiversity)

There are many **medicinal** and **economic uses** of biodiversity. Genes of wild species are used to confer new properties like disease resistance in plants. Wild life also provides some **life saving medicines**. The biodiversity is helpful in search of genes. These are various aspects - **economical, ecological, cultural** and **aesthetic benefits**.

1.6 Ecological Role of Biodiversity

Biodiversity also provides valuable **indirect services** through natural ecosystems by providing **pollinators** to plants. This is useful in purification of water and air. It can help in checking floods.

2. GENETICALLY DIVERSE SPECIES

Can tolerate environmental stress and these cannot be eliminated from an ecosystem.

3. WHAT THREATENS BIODIVERSITY

Mass extinction, anthropogenic activities and nature plays role in eliminating a species. The species become **extinct** due to **natural disturbances, pollution** and **humans activities**.

Industrial revolution is another cause of **extinction of species**.

4. THE IUCN RED LIST

World conservation Union (formerly called the IUCN) **Red list categories** : The rare species of wild life are divided into endangered, vulnerable, rare and threatened.

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(c) G-16 Summit
(d) MAB Programme

Ans : SQP 2020

The historic convention on biological diversity held in Rio de Janeiro (Brazil) in 1992 is known as Earth Summit (1st). The explanation for other options is CITES (Convention on International Trade in Endangered Species of wild flora and fauna) has helped in restricting poaching and loss of rare species.
MAB stands for Man and Biosphere Programme which undertakes establishment and maintenance of biosphere reserves.
Thus (b) is correct option.

50. What is common to the techniques?
1. In vitro fertilization.
2. Cryopreservation.
3. Tissue culture.

(a) All are in-situ conservation methods
(b) All are ex-situ conservation methods
(c) All require ultra modern equipment and large space.
(d) All are methods of conservation of extinct organisms.

Ans : FOREIGN 2011

All the three above mentioned techniques are ex-situ conservation methods. At present gametes of threatened species can be preserved in viable conditions for longer duration by cryopreservation method (at very low temperature - 196°C).
Fertilization can be achieved in laboratory-in vitro, and species can be improved or propagated by tissue culture method, a plant breeding principle.
Thus (b) is correct option.

51. Which of the following National Park is home to the famous musk deer or hangul?
(a) Eaglenest Wildlife Sanctuary, Arunachal Pradesh
(b) Dachigam National Park, Jammu & Kashmir
(c) Keibul Lamjao National Park, Manipur
(d) Bandhavgarh National Park, Madhya pradesh

Ans : COMP 2013

Dachigam National Park, Jammu & Kashmir is home to the famous musk deer or hangul.
Thus (b) is correct option.

52. In which of the following both pairs have correct combination?
(a) In situ conservation : Seed Bank
Ex situ conservation : National Park
(b) In situ conservation : Tissue culture
Ex situ conservation : Sacred groves
(c) In situ conservation : National park
Ex situ conservation : Botanical Garden
(d) In situ conservation : Cryopreservation
Ex situ conservation : Wildlife Sanctuary

Ans : SQP 2019

In situ conservation : National park
Ex situ conservation : Botanical Garden
In situ conservation - hotspot, biosphere reserves, national parks, sanctuary. Ex-situ conservation - Zoological parks, Botanical gardens and wildlife safari parks, seed banks etc.
Thus (c) is correct option.

53. Exotic species introduced in India are :
(a) Lantana camara, water Hyacinth.
(b) Water Hyacinth, Prosopis cineraria.
(c) Nile Perch, Ficua religiosa.
(d) Ficus religious, Lantana camara.

Ans : OD 2008

A species of organisms that is not native to a locality and having been moved there from its natural range by humans been moved there from its natural range by humans or other agents is called exotic species.
E.g. Lantana camara, water Hyacinth.
Thus (a) is correct option.

54. According to IUCN red list, what is the status of Red Panda (Ailurus fulgens)?
(a) Critically endangered
(b) Endangered species
(c) Vulnerable species
(d) Extinct species

Ans : DELHI 2016

Red panda is an endangered species because it is facing a very high risk of extinction in near future.
Thus (b) is correct option.

55. Which of the following is correctly matched?

(a) Aerenchyma	– Opuntia
(b) Age pyramid	– Biome
(c) Parthenium hysterophorus	– Threat of biodiversity
(d) Stratification	– Population

Ans : COMP 2011

Parthenium hysterophorus – Threat of biodiversity
Parthenium hysterophorus (carrot grass) is an alien species introduced inadvertantly for some

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a secondary centre for some animals like cattle, sheep, yak, donkey horse, goat etc.

19. CONVENTION ON BIODIVERSITY

Convention on Biodiversity in an important International promoting biodiversity conservation globally. **IUCN** and **WWF** are among the leading **Internation organizations** concerned with biodiversity conservation.

20. THE IUCN THREAT CATEGORIES AS PER RED DATA BOOK

	Red list category	Definition and Explanation
1.	Extinct	A taxon is Extinct when there is no reasonable doubt that last individual has died.
2.	Extinct in the wild	A taxon is Extinct in the wild when exhaustive surveys is known and or expected habitats, have failed to record an individual.
3.	Critically endangered	A taxon is Critically Endangered when this is facing an extremely high risk of extinction in the wild in the immediate future.
4.	Endangered	A taxon is Endangered when this is not critically endangered but is facing a very high risk of extinction in the wild in the near future.
5.	Vulnerable	A taxon is Vulnerable when this is not critically endangered or endangered, but is facing a high risk of extinction in the wild in the medium-term future.
6.	Lower risk	A taxon is Lower Risk when this has been evaluated and does not satisfy the criteria for critically endangered, endangered or vulnerable.
7.	Data deficient	A taxon is Data Deficient if there is inadequate information to make a direct or indirect, assessment of its risk of extinction.
8.	Not evaluated	A taxon is Not Evaluated when this has not yet been assessed.

OBJECTIVE QUESTIONS

1. The total number of Biodiversity hot spots in the world is:
(a) 25 (b) 9
(c) 34 (d) None of these

Ans : **OD 2024, 2005**
There are 34 areas around the world which are qualified as Biodiversity hotspots. These hotspots represent 2.3% of the total Earth's land surface.
Thus (c) is correct option.

2. Red Data Book includes list of:
(a) Endangered plants (b) Rare plants
(c) Threatened animals (d) All of the above

Ans : **OD 2017**
Red data book is a book that contains a list of endangered and threatened plants, animals species. It helps us in providing complete information for research studies and also for monitoring programme on rare and endangered species and their habitats.
Thus (d) is correct option.

3. Rhino sanctuary is located in which state?
(a) Assam (b) West Bengal
(c) Uttar Pradesh (d) Bihar

Ans : **OD 2011**
Rhino sanctuary is located in Guwahati, Assam. It is called as pobitra wildlife sanctuary. It has a dense population of great Indian one-horned rhinoceros.
Thus (a) is correct option.

4. Gir National Park is famous for:
(a) Deer (b) Lion
(c) Leopard (d) Birds

Ans : **OD 2007**
Gir National park is famous for its Asiatic lions. It is located in Gujrat.
Thus (b) is correct option.

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5. Dodo is
(a) Extinct species
(b) Endangered species
(c) Threatened species
(d) all of these

Ans : **OD 2016**
Dodo is an extinct flightless species of bird that was endemic to the island of Mauritius, east of Madagascar in the Indian ocean.
Thus (a) is correct option.

6. Kanha National park is famous for:
(a) Birds
(b) Crocodiles/Alligators
(c) Rhinoceros
(d) Tigers

Ans : **OD 2013, SQP 2010**
Kanha National Park is famous for tigers. It is present in Madhya Pradesh.
Thus (d) is correct option.

7. Chipko Movement is associated with:
(a) cultivation of trees
(b) protecting trees from felling down by human beings
(c) giving up tobacco abuse
(d) all of these

Ans : **OD 2013**
The Chipko movement is a movement that practiced the Gandhian methods of satyagraha and non-voilent resistance. This is mainly done through the act of hugging trees to protect them from being cut down. This was first started by Amrita Devi while protesting against a King's men to cut the tree. The modern Chipko movement began in the early 1970s in the Garhwal Himalayas of Uttarakhand.
Thus (b) is correct option.

8. In a National Park, protection is provided to:
(a) Flora
(b) Fauna
(c) Ecosystem
(d) Both Flora and Fauna

Ans : **OD 2012**
National parks are protected areas maintained by government for scientific, educational and recreational use. Here, major emphasis is laid on the present action of single plant or animal species.
Thus (d) is correct option.

9. Heavy rainfull during summer produces
(a) desert (b) grassland
(c) forest (d) wetland

Ans : **DELHI 2015**
During summer the land becomes dry and rainfall induces formation of grass and hence, heavy rainfall during summer produces grasslands.
Thus (b) is correct option.

10. The trees occurring in two seasons is the characteristic feature of
(a) temperate deciduous forest
(b) tropical savannah
(c) grassland
(d) coniferous forest

Ans : **SQP 2020**
In the deciduous forests, the leaves generally fall off during autumn. These trees are seen in temperate lands.
Thus (a) is correct option.

11. If the high altitude birds become rare or extinct, the plants which may disappear along with them are
(a) pine (b) oak
(c) orchids (d) Rhododendrons

Ans : **FOREIGN 2011**
The oak plant may disappear since they are seen at a high altitude and their dispersal is dependant on these birds.
Thus (b) is correct option.

12. Which one of the following is a pair of endangered species?
(a) Garden lizard and Mexican poppy
(b) Rhesus monkeys and sal tree
(c) Indian peacock and carrot grass
(d) Horn-bill and Indian aconite

Ans : **OD 2005**
Endangered species are species with low population numbers that are in considerable danger of becoming extinct Horn-bill and Indian Aconite are endangered species.
Thus (d) is correct option.

13. Which one of the following is correct matching of a plant, its habit and forest type where it normally occurs?
(a) Prosopis, tree, scrub
(b) Saccharum officinarum, grass, forest
(c) Shorea robusta, herb, tropical rain forest
(d) Acacia catechu, tree, coniferous forest

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Ans : **COMP 2019**

Prosopis fuliflora is a shrub or small tree native to Mexico, South America and the Caribbean. Its uses include forage, wood and environmental management.
Thus (a) is correct option.

14. One of the ex-situ conservation methods for endangered species is-
(a) wildlife sanctuaries
(b) biosphere reserves
(c) cryopreservation
(d) national parks

Ans : **SQP 2015**

Ex-situ conservation is the method of selecting plants or animals in places outside their natural homes, e.g. cryopreservation, tissue culture etc. They are the sources of genetic material for breeders and genetic engineering.
Thus (c) is correct option.

15. Genetic diversity in agricultural crops is threatened by
(a) Introduction of high yielding varieties.
(b) Intensive use of fertilizers
(c) extansive intercropping
(d) intensive use of biopesticides.

Ans : **OD 2015**

Genetic diversity is liable to undergo degradation and prone to mass scale destruction due to fungal and insects attacks and intensive use of biopesticides.
Thus (d) is correct option.

16. The Montreal protocol refers to
(a) persistent organic pollutants
(b) global warming and climate change
(c) substances that deplate the ozone layer
(d) biosafety of genetically modified organisms

Ans : **SQP 2020**

Montreal protocol (1987) was a landmark international agreement to protect the stratospheric ozone by agreeing to limit the production and use the ozone-depleting substances.
Thus (c) is correct option.

17. Biosphere reserves differ from National parks and Wildlife sanctuaries because in the former
(a) human beings are not allowed to enter
(b) people are an integral part of the system.
(c) plants are paid greater attention than the animals.
(d) living organisms are brought from all over the world and preserved for posterity.

Ans : **FOREIGN 2018**

Biosphere reserves area special category of protected areas of land or coastal environments where people are an integral component of the system.
Thus (b) is correct option.

18. Which part of the world has a high density of organism?
(a) Deciduous forests (b) Grasslands
(c) Tropical rain forests (d) Savannahs

Ans : **COMP 2010**

Tropical rain forests have a high density of organisms. Tropical rain forests are mainly found in America, South America, Cargo river basin of Africa, South East Asia. In this biome, rainfall and warmth are abundant. Plant growth is luxuriant. This biome possess more than half of the flora and fauna of the world. Productivity is very high. Diversity of life is so high that a hectare of the forest may have 200 species of trees. 70-80% of all insects and 80-85% of all birds are known from tropical forests.
Thus (c) is correct option.

19. Beta diversity is diversity
(a) in a community
(b) between communities
(c) in a mountain gradient
(d) on a plain

Ans : **DELHI 2019**

α, β, γ are the three types of ecosystem diversities where diversity is the diversity operating between communities.
Thus (a) is correct option.

20. Which one of the following pairs of geographical areas show maximum biodiversity in our country?
(a) Sunderbans and Rann of Kutch
(b) Eastern Ghats and West Bengal
(c) Eastern Himalaya and Western Ghats
(d) Kerala and Punjab

Ans : **COMP 2005**

The Eastern Himalayas Region includes Bhutan, north-eastern India, and southern, central, and eastern Nepal. It is home to 163 globally threatened species, including Asia's three largest herbicores - the Asian elephant (Elephas maximus), the greater one-horned rhinoceros (Rhinoceros unicornis), and the wild water buffalo (Bubalus bubalis)- and its largest carnivore,

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5. EXTINCTION OF SPECIES

Extinction of species is a natural process but man is disturbing the natural habitats and ecosystems.

Exotic (alien) Species : There are new species entering a geographical area. The native species disappear. The examples are : **Nile perch** was introduced into **lake Victoria**. Lantana camara invaded many forest lands in many parts of India.

6. NATURAL EXTINCTION

The dinosaurs disappeared during **cretaceous** period. The mass extinction occurs rarely and in millions of years. When there is charge in natural environmental conditions, some species disappear and the another species is adapted there. It takes place at a **slow rate**. It is called **background** or natural extinction.

7. MASS EXTINCTION

The large groups of animals became extinct with in a time of million years. Some species became extinct due to **catastrophes** in geological history.

8. ANTHROPOGENIC EXTINCTION

It refers to the extinction by humans activities. So it is called **man-made extinction**.

9. HABITAT DESTRUCTION

The **primary cause** for loss of biodiversity is **habitat destruction. Invasive species** are not second only to habitat destruction as a major cause of extinction of species.

10. FRAGMENTATION

It develops **barriers** which **limit potential** of one species to **colonise** new sites/areas. The species is now divided into smaller and smaller populations that lose capability to sustain. The species now becomes more **vulnerable** to extinction by means of fire, wind and predators.

11. INTRODUCTION OF EXOTIC SPECIES

The allien/exotic species of **predators** and introduced in an ecosystem, may eliminate the native species.

12. ENVIRONMENTAL POLLUTION

Man-made and natural pollution changes the **quality** of a **habitat** and can decrease the species and populations in lakes. Some species leads to **mortality** by **lead poisoning** e.g., Swans, cranes, ducks.

Eutrophication leads to loss of species diversity.

13. CONSERVATION OF BIODIVERSITY

There are two main **approaches** (i) in-situ and (ii) ex-situ.

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13.1 In-situ Conservation

By this method, we can protect **endangered** species in its natural habitat by defending and protecting from predators etc.

By this conservation includes the protected areas, **national parks, wildlife sanctuaries** sacred forests as well as **biosphere reserves**.

13.2 Ex-situ Conservation

It is known as **off site** conservation to protect endangered species whether a plant or animal. It is removed from the **threatened habitat** and kept under the supervision and care of humans.

There are 275 zoos, deer parks, **35 botanical gardens** in India.

14. METHODS OF EX-SITU CONSERVATION

There are 3 methods of ex-situ conservation : (i) Zoos, (ii) botanical gardens and (iii) arborata. The plants which are endangered may be preserved in **seed** or **germplasm banks**.

15. CRYOPRESERVATION

This includes the storage of material of **ultra low** temperatures. The eggs/sperms and embroys are protected by cryopreservation method.

16. PEOPLE AND GOVERNMENTS PARTICIPATION IN BIODIVERSITY CONSERVATION

Not only the government but also the people untidily can save biodiversity of plants/animals. The biodiversity must be conserved by making strict laws and then **enacting** the **legislation**.

Indian government passed a bill on Biodiversity to protect it in Dec, 2003. **Women** play role in saving the forests. **Chipko Andolan** was launched in Tehri garhwal to save trees by hugging them.

17. INTERNATIONAL EFFORTS FOR CONSERVATION OF BIODIVERSITY

The **Earth summit** held in 1992 at Rio de Janeiro resulted into **convention on Biological biodiversity**.

18. BIODIVERSITY CONSERVATION IN INDIA

Indians region is the centre of diversity of animal species like chicken, water buffalo, camel, zebu, crop plants like rice, sugarcane, tea, banana, cucurbita, spices bamboos and tree cotton. It is

is permitted only if does not interface with the project. In all the other 3 options, it is prohibited.
Thus (a) is correct option.

29. Biodiversity is of importance as it offers
(a) Stability of ecosystems
(b) Stability of atmosphere
(c) Stability of species
(d) Stability of research

Ans : **OD 2020**

Biodiversity helps in maintaining ecological stability. The ecosystems have an ability to maintain its original nature even after disturbances occur within it, with the help of biodiversity.
Thus (a) is correct option.

30. Incorrect statement is:
(a) Western Ghats have a greater amphibians species diversity than the Eastern Ghats.
(b) India has more than 50,000 genetically different strains of rice and 1000 varieties of mango.
(c) India has greater ecosystem diversity than a Scandinavian country like Norway.
(d) For many taxonomic groups, species inventories are more complete in tropical than in temperate countries.

Ans : **DELHI 2015**

A forest in a tropical region like Equador has up to 10 times as many species of vascular plants as a forest of equal area in a temperate region like the Midwest of the USA.
Thus (d) is correct option.

31. Which of the following countries has the largest biodiversity?
(a) Brazil (b) South Africa
(c) Russia (d) India

Ans : **COMP 2012**

Climate of countries tropical latitude like Brazil climate remain relatively undisturbed, constant and predictable giving tune for diversification, which favours rich biodiversity.
Thus (a) is correct option.

32. Which of the following is not a cause for loss of biodiversity?
(a) Destruction of habitat
(b) Invasion by alien species
(c) Keeping animals in zoological parks
(d) Over-exploitation of natural resources

Ans : **OD 2013**

Keeping animals in zoological parks is not a cause for loss of biodiversity.
Some of the major causes of biodiversity loss are
1. Destruction of natural habitat (primary cause).
2. Introduction of exotic (alien species) with indigenous species.
3. Over exploitation of natural resources.
4. Co-extinction of species.

Thus (c) is correct option.

33. Which of the following is not a cause for loss of biodiversity?
(a) Lantana (b) Cynodon
(c) Parthenium (d) Eichhornia

Ans : **SQP 2009**

Cynodon (doob grass) is not an invasive alien species. The other three Parhenium (congress or carrot grass), Eichhornia (water hyacinth) and Lantana are alien species which pose threat to native species.
Thus (b) is correct option.

34. Where among the following will you find pitcher plant?
(a) Rain forest of North-East India
(b) Sunderbans
(c) Thar desert
(d) Western ghats

Ans : **FOREIGN 2011**

Pitcher plant (Nepenthes), an insectivorous plant, is found in rain forest of North-East India. These type of plants generally grow in nitrogen deficient soil.
Sunderbans are rich in fauna and flora. Mangroove plants are the characteristic of Sunderbans.
Western ghats are rich in biodiversity. Xerophytes are more common in Thar deserts.
Thus (a) is correct option.

35. Which one of the following is not a feature of biodiversity hotspots?
(a) Large number of species
(b) Abundance of endemic species
(c) Mostly located in the tropics
(d) Mostly located in the polar regions

Ans : **DELHI 2019**

Biodiversity hotspots are characterised by large number of flora and fauna, abundance of endemic species and also large number of alien or exotic species. They are mostly found in tropical and temperate regions. There are no biodiversity hotspots in polar regions.
Thus (d) is correct option.

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the tiger (Panthera tigris), as well as several large birds such as vultures, adjutant strokes, and hornbills. The Western Ghats are amongst the world's biodiversity Hotspots. The various human-induced threats to the rich biodiversity and the large number of endemic species have been identified and highlighted by the recently completed National Biodiversity Strategy and Action Plan, Western Ghats Ecoregion.
Thus (c) is correct option.

21. A tree species in mauritus failed to reproduce because of the extinction of a fruit-eating bird. Which one of the following was that bird?
(a) Dove (b) Dodo
(c) condor (d) Skua

Ans : **OD 2020**

Dodo became extinct in 14th century from Mauritius because of large-scale hunting. Dodo was helpful in pollinating and propagating seed of this tree species.
Thus (b) is correct option.

22. Tectonic is the study of
(a) volcanos (b) earth's crust
(c) sand dunes (d) Sun

Ans : **OD 2007**

Tectonic is the study of the earth's crust. It was considered that earth was made up of tectonic plates.
Thus (b) is correct option.

23. If the Bengal tiger becomes extinct
(a) Hyenas and wolves will become scare
(b) The wild area will be safe for man and domestic animals
(c) Its gene pool will be lost for ever
(d) The population of beautiful animals like deers will be stabilized.

Ans : **COMP 2008**

If bengal tiger becomes extinct, its gene pool will be lost forever. There are various methods for conservation of biodiversity like formation of botanical gardens, zoological park, sperm bank, gene bank etc.
Thus (c) is correct option.

24. Which of the following is considered a hot-spot of biodiversity in India?
(a) Indo-Gangetic Plain (b) Eastern Ghats
(c) Aravalli Hills (d) Western Ghats

Ans : **SQP 2020**

Hot spot are those areas which were rich in biodiversity but now under threat due to direct or indirect interference of human activities. These regions are on the edge to get some of their species extinct due to humans. Westerns Ghats in India are under threat due to continuous developmental activities and Doon valley is under threat due to continuous mining activities.
Thus (d) is correct option.

25. The largest Tiger reserve in India is
(a) Nagarhole (b) Valmiki
(c) Nagarjunsagar-Srisailam (d) Periyar

Ans : **COMP 2015**

Nagarjunsagar-Srisailam Tiger Reserve is the largest Tiger reserve in India and the only Tiger Reserve in Andhra Pradesh state.
Thus (c) is correct option.

26. Dense evergreen vegetation of broad sclerophllous leaves and shrubs with fire resistant plants is known as:
(a) Chaparral vegetation
(b) Savannah vegetation
(c) Steppe grassland
(d) Tundra vegetation

Ans : **DELHI 2018**

Chaparral, vegetation composed of broad-leavedevergreen shrubs, bushes and small trees usually less than 2.5 m (about 8 feet) tall; together they often form dense thickets.
Thus (a) is correct option.

27. Which is an advantage of ex-situ conservation?
(a) Cheap method
(b) Converse large number of species together
(c) Genetic process for breeding/long life
(d) Existence in natural habitat

Ans : **SQP 2007**

Endangered species can be provided the conditions required for larger life with captive breeding and genetic techniques for development of the species which are healthy and more productive.
Thus (c) is correct option.

28. The activities of cultivation of land, timber harvesting is permitted in:
(a) Sanctuaries
(b) National Parks
(c) Protected Areas
(d) Biosphere Reserves

Ans : **FOREIGN 2020**

Sanctuaries are the areas where only wildlife is present. So, cultivation, harvesting of timber, etc.

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country.

(b) African catfish is not a threat ot indigenous catfishes.

(c) Steller's sea cow is an extinct animal.

(d) Lantana is popularly known as carrot grass.

Ans : **OD 2006**

Stellar's sea cow (from Russia) is a recently extinct animal.
Parthenium (carrot grass) is an exotic weed, which grows rapidly and adversly affects the native species.
Africal catfish is also an alien species which adversly affects the growth of indigenous Clarias batrachus-our local species.
Lantana camara, another alien species, is also strongly competing with native species.
Thus (c) is correct option.

44. Among the ecosystem mentioned below, where can one find maximum biodiversity?

(a) Mangroves

(b) Desert

(c) Coral reefs

(d) Alpine meadows

Ans : **DELHI 2017**

Coral reefs are the most productive ecosystem (2000-6000 kcal/m^2/y) and form the most diverse part of coastal region providing a home to fish molluscs, crustaceans sponges, cnidarians, etc.
Mangroves, found in coastal regions, usually have plants growing in swampy and saline water, deserts have mostly xerophytic species and Alpine meadows are related to high altitudes and do not show much tree growth.
Thus (c) is correct option.

45. Which of the following forests is known as the Lungs of the planet Earth?

(a) Taiga forest

(b) Tundra forest

(c) Amazon rain forest

(d) Rainforests of North-East India

Ans : **FOREIGN 2014**

Amazon is a rain forest that convers most of the Amazon basin of South America and territory including nine nations. It represents over half of the planet's rain forests and exhibits the largest and the most diversified tropical rainforest.
It is home to more than 40000 species of plants, 3000 of fishes, 1300 of birds, mammals, amphibians, reptiles and more than 125000 invertebrates. Amazon rainforest is popularly called the lungs of the planet earth because its vegetation continuously recycles carbon dioxide into oxygen.
Taiga forest, present in broad belt of Northern hemisphere, represents the largest terrestrial biome.
Tundra forest is a biome where tree growth is hindered by low temperature and short growing season. Rain forests of North-East India are tropical forests with a natural reservoir of genetic diversity.
Thus (c) is correct option.

46. The active chemical drug reserpine is obtained form:

(a) Datura (b) Rauwolfia

(c) Atropa (d) Papaver

Ans : **SQP 2012**

Rauwolfia vomitoria is the source of active chemical drug reserpine, which is prescribed in hypertension and act as tranquilizer. Datura is a plant with hallucinogenic properties. Drug belladonna is obtained from Atropa belladonna and drug opium is obtained from Papaver somniferum.
Thus (b) is correct option.

47. Which of the following group exhibit more species diversity?

(a) Gymnosperms (b) Algae

(c) Bryophytes (d) Fungi

Ans : **COMP 2010**

Fungi are group of eukaryotic heteromorphic organisms with diverse forms, sizes, physiology and mode of reproduction. They exhibits more specific diversity. This is followed by algae, bryophytes and then ferns and allilies.
Thus (d) is correct option.

48. Which of the below mentioned regions exhibit less seasonal variations?

(a) Tropics (b) Temperates

(c) Alpines (d) Both (a) and (b)

Ans : **OD 2009**

Maximum biodiversity is observed in tropics as the tropical region exhibit less seasonal variations, i.e., remain undisturbed.
The temperate region are more seasonal, less constant and exhibit less species diversity. Also, alpines with low temperature and high altitudes show less diversity.
Thus (a) is correct option.

49. The historic convention on biological diversity held in Rio de Janeiro in 1992 is known as:

(a) CITES Convention

(b) The Earth Summit

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36. Mild grazing in grassland by herbivores.
(a) Retards growth of grasses
(b) Arrest growth of grasses
(c) Stimulates growth of grasses
(d) Destroy vegetation

Ans :

Grazing helps to promote the growth of native plants and grasses. By livestock grazing, the non-native grasses are controlled and the native plants can redevelop.
Thus (c) is correct option.

37. What is common to the following plants Nepenthes, Psilotum, Rauwolfia and Aconitum?
(a) All are ornamental plants.
(b) All are phylogenic link species.
(c) All are prone to over exploitation.
(d) All are exclusive present in the Eastern Himalayas.

Ans : **COMP 2020**

All of the above plants are prone to over-exploitation due to their respective properties. Nepenthes (pithcher plant) is an insectivorous plant. Psilotum is a pteridophyte and Aconitum is a medicinal plant.
Thus (c) is correct option.

38. The one-hornes rhinoceros is specific to which of the following sanctuary?
(a) Bhitar Kanika (b) Bandipur
(c) Kaziranga (d) Corbett park

Ans : **DELHI 2013**

Kaziranga National Park is situated in Golaghat and Nagaon district of (Assam). One horned rhinoceros is specific to this park.
While Corbett National Park is situated in district Nainital (Uttarakhand) and is specific for tiger. It is the first National Park of India, which is famous for tigers.
Bandipur National Park (Mysore) too is specific for tigers. Bhitar Kanika National Park is located in Odisha and is specific for salt water crocodile.
Rest of the given set of extinct animals matched with the provided countries are not true.
Thus (c) is correct option.

39. Amongst the animal groups given below, which one has the highest percentage of endangered species?
(a) Insects (b) Mammals
(c) Amphibians (d) Reptiles

Ans : **FOREIGN 2020**

Amphibians have the highest percentage presently, 32% of all amphibian species in the world face the threat of extinction. Other than these, 23% of all mammal species and 12% of all bird species also facing the risk.
Thus (c) is correct option.

40. Which one of the following is an endangered plant species of India?
(a) Rauwolfia
(b) Santalum album (sandal wood)
(c) Cycas beddonei
(d) All of the above

Ans : **OD 2019**

All of the above mentioned plants are endangered plant species of India. Rauwolfia serpentina (sarpgandha), Santalum slbum (sandal wood) and Cycas beddonei are facing the threat of extinction due their medicinal and commercial importance.
Thus (d) is correct option.

41. What is common to Lantana, Eichhornia and Africal catfish?
(a) All are endangered species of India
(b) All are key stone species
(c) All are mammals found in India
(d) All the species are neither threatened nor indigenous species of India.

Ans : **SQP 2013**

All of the three above mentioned species are neither threatened nor indigenous species of India. Lantana, Eichhornia (water hyacinth) and African catfish (Clarias gariepinus) all are alien (exotic species) which are invasive and have an harmful impact resulting in extinction of the indigenous species.
Thus (d) is correct option.

42. The extinction of passenger pigeon was due to.
(a) Increased number of predatory birds.
(b) Over exploitation by humans.
(c) Non-availability of the food.
(d) Bird flu virus infection.

Ans : **COMP 2013**

Extinction of passenger pigeon (Ectopistes migratorius) was due to over exploitation by human beings. Factors like increase in number of predatory birds, non-availability of food and bird flu virus infection did not contribute to the extinction of passenger pigeon.
Thus (b) is correct option.

43. Which of the following statements is correct?
(a) Parthenium is an endemic species of our

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economic use turned invasive causing decline or extinction of the indigenous species.
Thus (c) is correct option.

56. With reference to competitive exclusion, which one of the following became extinct when browsing goats were introduced in Galapagos Islands?
(a) Darwin's finches (b) Chathamalus
(c) Abingdon tortoise (d) Warblers

Ans : **FOREIGN 2015**

Browsing goats when introduced in Galapagos island, them Abingdon tortoise became extinct, because these goats destroyed their food and territory. Galapagos island is also famous for adaptive radiation phenomenon is Darwin finches.
Thus (c) is correct option.

57. Which of the following is the most important cause of animals and plants being driven to extinction?
(a) Alien species invasion.
(b) Habitat loss of fragmentation.
(c) Coextinctions.
(d) Overexploitation.

Ans : **COMP 2020**

There are four major causes of biodiversity loss in which most important cause driving animals and plants to extinction is habitat loss and fragmentation.
Thus (b) is correct option.

58. What is the full from of MAB?
(a) Man and Biosphere
(b) Man and Biosphere Reserve
(c) Man and Biosphere Reserve Programme
(d) Man and Biosphere Programme

Ans : **SQP 2020**

Man and Biosphere Programme (MAB) is an intergovernmental scientific programme that aims to establish a scientific basis for the improvement of relationship between people and their environment. This programme was launched in 1971 by UNESCO.
Thus (d) is correct option.

59. Wildlife Protection Act, India was implemented in the year
(a) 1982 (b) 1988
(c) 1972 (d) 1970

Ans : **FOREIGN 2005**

Wildlife Protection Act, 1972 is an act of the Parliament of India enacted for protection of plant and animal species. It establishes schedules of protected plant and animal species. Hunting or harvesting these species was largely outlawed.
Thus (c) is correct option.

60. An area is declared as hotspot when
(a) it has 1500 more endemic species and 75% of its original habitat is lost.
(b) it has 1500 or more vertebrate species and 75% of its original habitat is lost.
(c) it has more than 2000 species of plants.
(d) most of the species inhabiting the area is facing the risk of extinction.

Ans : **OD 2015**

Biodiversity hotspots are geographical areas that contain high levels of species diversity, but are threatened with extinction.
To qualify as a hotspot, a region must meet two strict criteria:
1. It must contain at least 1500 species of vascular plants (> 0.5 percent of the world total) as endemics.
2. It has lost at least 75% of its original habitat.

Thus (a) is correct option.

61. The distribution of species diversity on earth may be best described as
(a) it is uniformly distributed.
(b) it is highest in tropics.
(c) it is highest in polar regions.
(d) it is highest is Southern hemisphere and lowest in Northern hemisphere.

Ans : **DELHI 2011**

The distribution of species diversity is highest in tropical regions of the earth, while it is lowest in the polar regions due to the optimum conditions prevailing in tropics.
Thus (b) is correct option.

62. One of the following statements is incorrect with reference to biodiversity. Identify it.
(a) Biodiversity increases with higher altitudes to lower altitudes
(b) Depletion in genetic diversity of crop plants is mainly due to the introduction of better varieties with high yield, disease resistance, etc.
(c) The richest reservoirs of animal and plant life (species richness) with few or no threatened species are called biodiversity hotspots.
(d) Biodiversity decreases from the equator to polar regions.

Ans : **FOREIGN 2006**

Out of all the options given in the question the only inappropriate answer is about **biodiversity**

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ASSERTION AND REASON

DIRECTION : Each of these questions contains as Assertion following by Reason. Read them carefully and answer the question on the basis of following options. You have to select the one that best describes the two statements.

79. **Assertion :** In tropical rain forests. O-Horizon and A-Horizon of soil profile are shallow and nutrient-poor.
Reason : Excessive growth of micro-organisms in the soil depletes its organic content.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **FOREIGN 2006**
O-horizon occupies the topmost soil and is rich in mineral and decomposed organic matter (humus). A-horizon is dark coloured and has abundant minerals mixed with humus.
Thus (c) is correct option.

80. **Assertion :** Tropical rain forests are disappearing fast from developing countries such as India.
Reason : No value is attached to these forests because these are poor in biodiversity.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **OD 2006**
Tropical rain forests are located in the equatorial regions where the annual rainfall exceeds 140 cm. They are also called jungles and cover one twelfth of earth's surface but contain more than half of the earth's flora and fauna (i.e., rich in biodiversity). Now-a-days these forests are disappearing due to excessive cutting of forests for domestic purposes like fuel, furnitures, accommodations, cloths, resin, gum, etc.
Thus (c) is correct option.

81. **Assertion :** A sanctuary is formed for the conservation of animals only.
Reason : Restricted human activities are allowed in sanctuaries.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **DELHI 2011**
A sanctuary is an area which is reserved for the protection of wild animals only. The activities like harvesting of timber, collection of minor forest products and private ownership rights are allowed, however, such activities should not have any adverse effect on animals.
Thus (a) is correct option.

82. **Assertion :** Communities that comprise of more species tend to be more stable.
Reason : A higher number of species results in less animal variation in total biomass.
(a) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) The Assertion is correct but Reason is incorrect.
(d) Both the Assertion and Reason are incorrect.

Ans : **OD 2024, COMP 2020**
Communities with higher number of species are more stable as it can resist occasional disturbances. A stable community should show less variation in productivity from year to year and resistance towards alien species.
Thus (a) is correct option.

VERY SHORT ANSWER QUESTIONS

83. Why is genetic variation important in the plant Rauwolfia vomitoria?

Ans : **OD 2005**
Genetic variation is important as it affects the production of the drug reserpine in the medicinal plant Rauwolfia

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Ans : **OD 2013**

The cheetah is a member of cat family. It has been known to exist in India for a very long time. But due to hunting and other purposes, cheetah in India became extinct before the 20th century.
Thus (b) is correct option.

71. Largest tiger population is found in
(a) Sundarbans National Park
(b) Corbett National Park
(c) Ranthambhore National Park
(d) Kanha National Park

Ans : **DELHI 2020**

As compared to other reserves in the world, Sundarbans National Park has the largest tiger population. It also reserves the salt water crocodiles, Gangetic dolphins, chitals, wild boars, rhesus monkeys, etc.
Thus (a) is correct option.

72. The greatest threat to genetic diversity in agricultural crops is
(a) extensive use of insecticides and pesticides
(b) extensive mixed cropping
(c) introduction of high yielding varieties
(d) extensive use of fertilizers

Ans : **COMP 2011**

Genetic diversity is the diversity in the number and types of genes as well as chromosomes present in different species and the variations in the genes and their alleles in the same species. Introduction of high yielding varieties is the greatest threat to genetic diversity in agricultural crops.
Thus (c) is correct option.

73. In India, we find mangoes with different flavours, colours, fibre content, sugar content and even shelf life. The large variation is an account of
(a) species diversity
(b) induced mutations
(c) genetic diversity
(d) hybridisation

Ans : **OD 2011**

Genetic diversity is the basis of formation of new species of mangoes with different flavour, colour, fibre content, sugar content and even shelf-life.
Thus (c) is correct option.

74. Identity the odd combination of the habitat and the particular animal concerned.
(a) Dachigam National Park – Snow Leopard
(b) Sundarbans – Bengal Tiger
(c) periyar – Elephant
(d) Rann of kutch – Wild Ass

Ans :

Dachigam National Park – Snow Leopard
Dachigam National park is situated near Dal lake in Jammu and Kashmir. It is known for the conservation of the most endangered Hangul or Kashmir stag in paramount.
Thus (a) is correct option.

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75. One of endangered species of Indian medicinal plants is that of
(a) Podophyllum (b) Ocimum
(c) Garlic (d) Nepenthes

Ans : **SQP 2018**

Podophyllum is an Indian endangered flora. Its dried roots and rhizomes are used in chronic constipation and tumorous growth.
Thus (a) is correct option.

76. Which one of the following pairs of organisms are exotic species introduced in India?
(a) Ficua religiosa, Lantana camara
(b) Lantana camara, water hyacinth
(c) Water hyacinth, Prosopis cinereria
(d) Nile Perch, Ficus religiosa

Ans : **FOREIGN 2015**

A species of organisms that is not native to a locality and having been moved there from its natural range by humans or other agents is called exotic species.
Thus (b) is correct option.

77. Number of endangered species of angiosperms are
(a) 487 (b) 15000
(c) 5000 (d) 3000

Ans : **DELHI 2018**

In India, 3000 species of angiosperms are endangered.
Thus (d) is correct option.

78. Biodiversity act of India was passed by the Parliament in the year.
(a) 1996 (b) 1992
(c) 2002 (d) 2000

Ans : **SQP 2019**

According to the US office of technology assessment (1987), biological diversity is the variety among living organisms and the ecological complexes, in which they occur. Biodiversity Act of India was passed by the Parliament in the year of 2002.
Thus (c) is correct option.

of a species, more sustenance, it has against environmental perturbations.

2. Genetically uniform populations are highly prone to diseases and harsh environment.

128. A particular species of wild cat is endangered. In order to save them from extinction, which is a desirable approach in situ or ex situ? Justify your answer and explain the difference between the two approaches?

Ans : **SQP 2015**

Ex situ is a better method, as in this method, the endangered animal is taken out from the natural habitat and placed in a special setting where they can be protected and given special care.

The gametes are preserved under very low temperature by cryopreservation.

	In situ conservation	**Ex situ conservation**
1.	It means conservations on site, i.e. protecting an endangered species in its natural habitat by maintaining the habitat itself and defending the species from predators and poachers.	It means off-site conservation, i.e. protecting an endangered species by removing it from the threatened habitat and placing it under the care of humans.
2.	This approach emphasizes on the protection of total ecosystem.	This approach restricts to the protection of genetic resources at population and species level.
3.	This approach includes methods of protection like hot spots, national parks, wildlife sanctuaries and bio-sphere reserves.	It is done through live collections of animals and plants in zoos, botanical gardens, seed banks etc.

129. Giving two reasons explain why there is more species biodiversity in tropical latitudes than it temperate ones?

Ans : **COMP 2014**

The reasons for more species biodiversity in tropical latitudes than in temperate ones are:

1. It remains relatively in disturbed for millions of years so longer time for diversification.
2. Less seasonal variations, more constant and predictable weather.
3. More solar energy available for productivity.

130. Why are (i) alien invasion and (ii) loss of habitat and fragmentation considered to be the major cause of loss of biodiversity? Explain with the help of one example each.

Ans : **DELHI 2013**

1. The alien species become invasive and cause a decline or extinction of indigenous species.

   e.g., The Nile Perch introduced into Lake Victoria led to the extinction of more than 200 species of cichlid fish in the lake.

2. Habitat loss and fragmentation deprive the organisms of their natural home and hence leads to their extinction.

   Fragmentation of habitats, affects the mammals and birds which require large territories and certain animals with migratory habits.

   e.g., When the Amazon forest in cut and cleared for conversion into grasslands, many species are affected.

131. Biodiversity must be conserved as it plays an important role in many ecosystem services that nature provides. Explain any two services of the ecosystem.

Ans : **FOREIGN 2011**

1. Humans derive countless direct economic benefits from nature food like cereals, pulses, fruits, firewood, fibres, construction.
2. The fast-dwindling Amazon forest is producing 20 percent of the total oxygen, without which we cannot live for a moment. Pollination is another service, ecosystem provide through pollinators like bees, bumble-bees, birds and bats.

132. Alien species are a threat to native species. Justify takjin examples of an animal and a plant alien species.

Ans : **COMP 2015**

The Nile perch introduced in lake Victora in East Africa led eventually to the extinction of more then 200 species of Cichild fish in the lake. African cat fish (Clarias gariepinus) for acquaculture purposes is posing threat to the indigenous catfishes in our rivers.

Invasive weed species Eicchornia (water hyacinth), Parthenium (carrot grass), Lantana have posed a threat to our native species.

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84. Name the three important components of biodiversity.

Ans : SQP 2020

1. Genetic diversity
2. Species diversity
3. Ecological diversity

85. Write a note on ecological diversity.

Ans : FOREIGN 2017

Ecological Diversity is related to species diversity and genetic diversity. India has a greater ecosystem diversity than a Scandinavian country. India has several ecosystems/biomes like alpine meadows, rain forests, deserts, wetlands, mangroves, coral reefs, etc.

86. India has more than 50,000 strains of rice. Mention the level of biodiversity it represents.

Ans : DELHI 2013

More than 50,000 strains of rice represent genetic biodiversity.

87. Write the level of biodiversity represented by a mangrove. Give another example falling in the same level.

Ans : COMP 2006

The mangroves represent biodiversity at ecological level. Other examples of ecological diversity are deserts, rainforests, coral reefs, etc.

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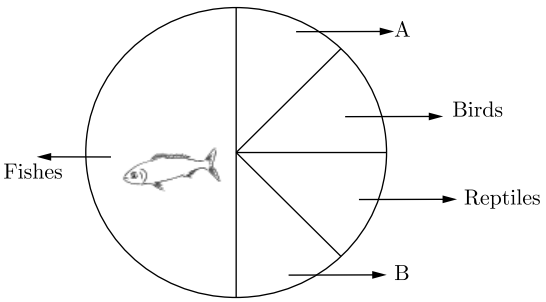
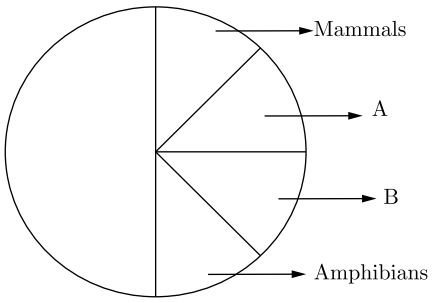
88. Identify 'A' and 'B' in the figure given below representing proportionate number of major vertebrate taxa.



Ans : Delhi 2014

In the given pie chart, A is Mammals and B is Amphibians

89. Name the unlabelled areas 'A' and 'B' of the pie chart representing biodiversity of vertebrates showing the proportionate number of species of major taxa.



Ans : FOREIGN 2009

In the given pie chart, A is Birds and B is Reptiles

90. Write the expanded form of IUCN.

Ans : SQP 2020

The International Union for Conservation of Nature and Natural Resources.

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91. What is Red Data Book?

Ans : OD 2012

Red Data Book is a compilation of data or records of species threatened to the risk of extinction (which are known to be endangered).

92. The Amazon rainforest is referred to as the 'lungs of planet'. Mention any one human activity which causes loss of biodiversity in this region.

Ans : OD 2006

Human activities causing loss of biodiversity in Amazon rainforest are

(i) Many plants are cut for cultivation of soybean.
(ii) Forests are converted to grasslands for raising beef cattle.

93. What do you mean by the term 'alien species'?

Ans : SQP 2019

Alien species are plants, animals or micro-organisms that are transported and established in a new area beyond their natural range

94. Give the names of some invasive species in India.

Ans : DELHI 2008

Invasive species in India are weed species like carrot grass (Parthenium), Lantana, water hyacinth (Eichhornia) and African catfish (Clarias gariepinus).

95. How much area of earth's land surface is covered by hotspots?

Ans : SQP 2013

Approximately 2%.

little biodiversity whereas South America has the greatest biodiversity on the earth. There are many hypothesis for higher biodiversity in tropics:

1. There are no unfavourable seasons in tropics. Continued favourable environmental condition has helped tropical organisms to flourish more.
2. There is more solar energy available in the tropics due to which productivity is higher and this contribute to greater diversity.
3. The tropical environment is older thus allowing more time for the evolution of greater number of plants and animals.

115. What is the significance of the slope of regression in a species-area relationship?

Ans : **FOREIGN 2013**

Alexander Von Humboldt observed that within a definite region the species richness increases upto some extent with increase in area. This relationship between species richness and area is a rectangular hyperbola for a large variety of taxa. On a logarithmic scale it is a straight line

$$\log S = \log C + Z \log A$$

where S = species richness

Z = slope of line (regression coefficient)

C = Y-intercept

A = Area

Z is generally $0.1 - 0.2$ regardless of taxonomic group or region i.e., when analysis of species-area relationship is done among small areas, the values of slopes of regression are remarkably similar regardless of the taxonomic group or the region. If analysis of species-area relationship is done among very large areas like a whole continent, the slope of regression line would be much steeper.

116. What are the major causes of species losses in a geographical region?

Ans : **OD 2006**

The major causes of species losses in a geographical region are as follows :

1. Habitat loss and f_{23}.ragmentation
2. Over-exploitation
3. Introduction of exotic species
4. Co-extinctions

117. How is biodiversity important for ecosystem functioning?

Ans : **DELHI 2019**

1. Biodiversity is essential for the stability of an ecosystem communities with more species tend to be more stable than those with less species. It is able to resist occasional disturbance.
2. Productivity of an ecosystem is directly influenced by its species richness. Ecosystem with higher biodiversity are more productive than ecosystem with lower biodiversity. For example, tropical forests are more productive than temperate forests.
3. Biodiversity is essential for maintenance and health of ecosystems.

118. What are sacred groves? What is their role in conservation?

Ans : **FOREIGN 2009**

They are the sacred forests patches around the places of worship. They are held in high esteem by tribal communities. Tribals do not allow to cut even a single branch of a tree in sacred groves. They are found in several parts of Indis e.g., Rajasthan (Aravalli hills), Madhya Pradesh (Sarguja, Bastar), Meghalaya and Maharashtra. Sacred groves help in the conservation of many endemic species (rare species) flourishing in that area.

119. Among the ecosystem services are control of floods and soil erosion. How is this achieved by the biotic components of the ecosystem?

Ans : **SQP 2016**

Plants play an important role in the control of flood and soil erosion. The roots of the plants bind the soil particles firmly and do not allow them from top-layers to be carried away by flowing water. Roots of the plants and the humus make the soil porous so that the water may percolate into the soil, which reduces the speed of the water flow.

120. The species diversity of the plants (22%) is much less than that of animals (72%). What could be the explanations to how animals achieved greater diversification?

Ans : **SQP 2016**

Compared to plants, animals have increased size and genetic variation. Also the animals possess complex nervous system to control and coordinate various body activities. Animals possess receptor organs for receiving various environmental stimuli and able to respond against them. The ability of locomotion is also a factor for greater diversification of animals.

121. Can you think of a situation where we deliberately want to make a species extinct? How would you

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various parts of earth. It is variety and variability among living organisms and the ecological complexes in which they occur.

Importance of Biodiversity

1. **Ecological Balance :** Each species in the ecosystem plays an important role in balancing the population, maintaining the food chain and natural cycles on the earth. They help to make environment a self sustaining system.
2. **Scientific value :** Wild life provides valuable information to naturalists and biologists in understanding the environment, ecology and behaviour.
3. **Economic value :** Wild species of animals not only provide meat but their skin is used as fur. Many animal products like horns and ivory, a good source of income for the country.
4. **Genetic Value :** Biological diversity has a great value as a gene bank of nature. It is of extreme importance in breeding programmes in agriculture, animal husbandry etc.
5. **Medicinal value :** There are so many varieties in the wild whose medicinal importance can help to develop treatment for various disease like cancer etc.

110. Write short notes on the following:

1. Red Data book
2. Reserved areas in India.

Ans : **FOREIGN 2013**

1. **Red Data book :** It is a book published by International union of conservation of Nature and Natural Resources (IUCN) (now called world conservation union) that contain information about all endangered and threatened species of plants and animals This book helps us in providing complete information for research, studies and also for monitoring programs on rare and endangered species and their habitat.
2. **Reserved areas in India :** These are the regions which are being reserved for conservation and protection of local flora and fauna. Following types of reserved areas are found in India.

(a) **National Park :** It is an area which is protected for preservation of wild life. India's first national park is Jim Corbett national park.

(b) **Wildlife sanctuary :** In these areas protection is given to wild life only.

(c) **Biosphere Reserves :** These are the protected areas, wherein people are an integral component of the system.

111. Define Endangered species with examples (at least one from plants and one from animals) (With name).

Ans : **OD 2009**

An endangered species is a species or population of animals, plants or other organisms that is in danger of becoming extinct. This could happen because there are few of that animal left, its predators have grown in number or the climate that it lives in, is changing, or the places it lives in have been destroyed. Eg. Asiatic lion, Albatross, Blue whale, Rafflesia, Georgia Aster.

112. What do you mean by Bioprospecting?

Ans : **DELHI 2013**

Bioprospecting is the exploration of biodiversity for new resources of social and commercial value. It is carried out by a wide range of established industries such as pharmaceuticals, manufacturing and agriculture as well as a wide range of comparatively new ones such as aquaculture, bioremediation, biomining, biomimetic engineering and nanotechnology. The benefits of bio-prospecting have emerged from such a wide range of organisms and environments worldwide that is not possible to predict what species or habitats will be critical to society, or industry, in the future. The benefits include an unexpected variety of products that include chemical, genes, metabolic pathways, structures, materials and behaviours. These may provide physical blue prints of inspiration for new designs.

113. What do you know about biodiversity?

Ans : **COMP 2010**

Biodiversity refers to the number, or abundance of different species living within a particular region. It represents the wealth of biological resources available to us. In short, it is described as degree of variation of life. Biological diversity encompasses microorganism, plants, animals and ecosystems such as coral reefs, forests, rain forests, deserts etc. It has three essential elements:

1. Genetic diversity.
2. Eco system diversity.
3. Species diversity.

The various factors that influence biodiversity include-temperature, altitude, precipitation, soils and their relation with other species.

114. Give three hypothesis for explaining why tropics show greatest levels of species richness.

Ans : **SQP 2020**

Biodiversity is not uniformly distributed throughout the world. Polar regions have very

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96. Give the names of biodiversity rich zones in India.

Ans : FOREIGN 2019

Western Ghats and Eastern Himalayas.

97. Why Western Ghats in India have been declared as biological hotspots?

Ans : OD 2015

Western Ghats are biological hotspots because they have high levels of species richness and endemism.

98. What are protected areas?

Ans : COMP 2007

Areas that protect and maintain ecologically unique and biodiversity rich regions.

99. How many biosphere reserves have been established in India?

Ans : DELHI 2016

There are 14 biosphere reserves established in India.

100. Write the importance of cryopreservation in the conservation of biodiversity.

Ans : Delhi 2011

In cryopreservation method, seeds of plants, eggs and sperms of animals of threatened species or the species at the verge of extinction can be preserved for a long time. Hence, serving the purpose of ex situ conservation.

101. Name the historic convention on biological diversity held at Rio in 1992

Ans : COMP 2020

The Earth Summit.

102. Name the sociobiologist who popularised the term biodiversity.

Ans : OD 2005

Edward Wilson

103. Western Ghats have a greater amphibian diversity than the Eastern Ghats. What can be inferred from this statement?

Ans : DELHI 2019

Western Ghats have high levels of species richness.

104. Give the name of a bird, which recently became extinct.

Ans : SQP 2006

Dodo

105. Apart from conserving individual plants and animals, what else needs to be conserved?

Ans : FOREIGN 2018

Viable seeds and gametes.

106. About 200 species of cichlid fish became extinct when a particular fish was introduced in lake Victoria of Africa. Name the invasive fish.

Ans : COMP 2009

Nile Perch

107. Which rainforest is called as 'Lung s of planet'?

Ans : OD 2017

Amazonian rainforest in South America.

SHORT ANSWER QUESTIONS

108. What is Biodiversity hotspot? Write down the name and specialities of two such hot spots found in India.

Ans : SQP 2010

Biodiversity hotspots are biogeographic region that are extremely rich in species diversity. They are characterised both by exceptional levels of plant and animals endemism and by serious level of habitat loss.

Among the 34 hotspots of the world, two are found in India extending into neighbouring countries. These two are the westerns Ghats/Sri Lanka and the Indo-Burma Region (covering the Eastern Himalayas).

1. **Eastern Himalayas :** It extends from North-Eastern India to Bhutan. The temperate forests are found at altitudes of 1780 to 3500 metres., that are exceptionally rich in endemic plant species. Numerous primitive angiosperm families e.g., Magnoliacease and Winteraceae and primitive genera of plants like Magnolia and Betula are found here.
2. **Western Ghats :** This region lies parallel to the western coast of Indian Peninsula. It cover Maharastra, Karnataka, Tamil Nadu and Kerala. These regions are rich in amphibians. The forests at low elevation (500 m above mean sea level) are mostly evergreen, while those found at 500-1500 m height are generally semi-evergreen forests.

   The Agasthyamalai hills, the Silent Valley and the new Amarambalam reverse are the main diversity regions of this area.

109. Define Biodiversity and explain its importance.

Ans : DELHI 2015

The term biodiversity was coined by Watter G Rosen in 1986. It refers to the occurrence of different types of genes, gene pools, species habitats and ecosystems in a particular place in

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justify it?

Ans : SQP 2020

The destruction of microorganisms harmful to the society is justified if they are not the essential biotic components of the ecosystem. Foe example, we are trying to eradicate disease causing organisms (Polio virus, HIV) from this world. The loss of few such harmful micro-organisms would not affect the functioning of ecosystem. Therefore, under these situations deliberately making a species extinct is justified.

122. Where are the main centres of biodiversity in Western Ghats? Mention two significance of conservation of biodiversity?

Ans : SQP 2015

Main centres of biodiversity in Western Ghats are - Agasthyamali hills, silent Valley and Amambalam Reserve.

Significance of biodiversity conservation

1. Conserved species can be used to restore degraded land, reintroduce species into wild and restock depleted populations.
2. It provides breeders and genetic engineers with a ready source of genetic material.

123. What will be consequences of loss of biodiversity?

Ans : DELHI 2006

Biodiversity is the biological wealth of world. The loss of biodiversity results in :

1. Decline in plant production
2. Extinction of various species
3. As man is dependent on biodiversity for food and other necessities, its loss will be hard pressed for mankind.

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124. List any three natural world heritage sites of India.

Ans : COMP 2020

	Site		State
1.	Kaziranga National Park	–	Assam
2.	Nanda Devi National Park	–	Punjab
3.	Sundarban National Park	–	West Bengal

125. Which type of conservation means **in situ** or **ex situ**, will help the largest number of species to survive? Explain.

Ans : OD 2020

In situ conservation will help the larger number of species to survive, because this method involves protection and conservation of the whole ecosystem and its biodiversity at all levels to protect to threatened species. Hotspots, protected areas and national parks are some of the methods used in situ conservation.

126. Difference between in situ and ex situ approaches of conserving biodiversity.

Ans : DELHI 2012

Difference between in situ and ex situ approaches of conserving biodiversity are as follows :

	In situ conservation	Ex situ conservation
1.	It means conservations on site, i.e. protecting an endangered species in its natural habitat by maintaining the habitat itself and defending the species from predators and poachers.	It means off-site conservation, i.e. protecting an endangered species by removing it from the threatened habitat and placing it under the care of humans.
2.	This approach emphasizes on the protection of total ecosystem.	This approach restricts to the protection of genetic resources at population and species level.
3.	This approach includes methods of protection like hot spots, national parks, wildlife sanctuaries and biosphere reserves.	It is done through live collections of animals and plants in zoos, botanical gardens, seed banks etc.

127. What does the term genetic diversity refer to? What is the significance of large genetic diversity in a population?

Ans : OD 2011

The term genetic diversity defers to the diversity of genes within a species.

It is important for the following reasons :

1. Greater the genetic diversity among organisms

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hotspots because these are the biographical regions which are both biologically rich reservoirs and deeply threatened by habitat loss and other human activities.
Thus (c) is correct option.

63. Management of National Park is controlled by
(a) State Government.
(b) Central Government.
(c) United Nations.
(d) Non-government Organisations.

Ans : **COMP 2015**

The management of National Park is controlled by United Nations. National Parks are large areas of native land set a site or designed for the conservation purposes of plants and animals.
The largest national park in world meeting the International Union of Conservation of Nation (IUCN) is the North-East Greenland National Park.
Thus (c) is correct option.

64. Breeding ground for migratory flamingo is
(a) area of Gulf of Kachch (Kutch).
(b) area between Khadir and Paccham islands in great Rann of Kachch (Kutch).
(c) area of great Rann of Kachch (Kutch) and little Rann of Kachch (Kutch).
(d) area of Nal Sarovar Bird Sanctuary.

Ans : **OD 2019**

Migratory flamingo is a type of wading bird in the genus Phoenicopterus. The breeding ground for them is the area between Khadir and pancham islands in great Rann of Kachch. They migrate from summer to winter due to the extreme aridity of salt flats during winter.
Thus (b) is correct option.

65. The government of India in 1980s has introduced a concept to work closely with the local communities for protecting and managing forests. The concept is
(a) Forest Research Institutes
(b) Panel of Local Communities for Forest Management
(c) Joint Forest Management
(d) Jhum Cultivation

Ans : **FOREIGN 2015**

Joint Forest Management (JFM) is introduced as to work closely with the local communities for protecting and managing forests.
Thus (c) is correct option.

66. Which one of the following is not used for ex situ plant conservation?
(a) Seed banks
(b) Shifting cultivation
(c) Botanical gardens
(d) Field gene banks

Ans : **OD 2020**

Shifting cultivation results into deforestation. Botanical gardens have collection of living plants for reference. Seed banks store seeds as a source for planting in case seed reserves elsewhere are destroyed. Field gene banks are a type of biorepository, which preserve genetic material.
Thus (b) is correct option.

67. Biosphere reserve programme started in India
(a) 1986 (b) 1984
(c) 1982 (d) 1988

Ans : **DELHI 2017**

Biosphere Reserve Programme was launched by UNESCO in 1971 under its Man and Biosphere Programme (MAB). But in India, it was launched in 1986.
Thus (a) is correct option.

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68. IUCN stands for
(a) Indian Union for Conservation of Nature
(b) International Union for Conservation of Nature
(c) Indian Union for chemical Nomenclature
(d) International Union for Conservation of Nutrients

Ans : **SQP 205**

IUCN or IUCNNR (International Union for Conservation of Nature and Natural Resources) is now known as WCU (World Conservation Union).
Thus (b) is correct option.

69. The alien species introduced into lake Victoria that was responsible for the extinction of cichlid fishes is
(a) African catfish (b) Water hyacinth
(c) Carrot grass (d) Nile perch

Ans : **COMP 2009**

The Nile perch, a voracious predator introduced to Lake Victoria as a food fish has already extinguished over one hundred species of native cichlid fish there.
Thus (d) is correct option.

70. The animal extincted from India is
(a) lion (b) cheetah
(c) deer (d) peacock

133. How do ecologists estimate the total number of species present in the world?

Ans : **COMP 2009**

Due to large number of species yet to be discovered in the tropics, biologists carry out a statistical comparison of temperate-tropical species richness of thoroughly studied group of insects and utilise this ratio to determine the relationship of remaining groups of plants and animals. This gives them the gross estimate of total number of species on earth. This number may range in between 20 to 50 million. However, according to Robert May, for his more better scientific studies, global species diversity is about 7 Million.

134. Give three hypotheses for explaining, why tropics show greatest levels of species richness.

Ans : **SQP 2008**

Following three hypotheses explain how tropics show greatest level of species richness.

1. **Undisturbance in tropics** : Speciation is usually a function of time, unlike temperate areas subjected to frequent glaciations in the past. This type of disturbance has not occurred or remained relatively undisturbed in tropical latitudes for millions of years. Tropical regions, thus, got a lone evolutionary time for species diversification.
2. **Constancy in season** : In tropical regions, environment is more constant, less seasonal and predictable. This is not so in temperate regions. Due to this stability and constancy, niche speciation takes place at a faster rate and leads to species richness.
3. **Availability of more solar energy** : Due to more availability of solar energy in tropics, productivity is higher. This contributes indirectly to greater species diversity.

135. What is the significance of the slope of regression in a species-area relationship?

Ans : **OD 2016**

A species relationship derived by Alexander Von Humboldt for area, it is a straight line on a logarithmic scale for wide range of taxa.

$$\log S = \log C + Z \log A$$

$S =$ Species richness,

$A =$ Area,

$Z =$ regression coefficient (Slope of line)

$C = Y -$ intercept.

If large continents are taken into account, value of Z differs, it comes between 0.6 to 1.2. Even the slope of line is steeper.

136. Explain what is meant by species diversity?

Ans : **SQP 2008**

The diversity includes the whole range of organisms found on earth. The number of identified species world wide is between 1.7 and 1.8 million. However the estimates of total known species may be 50 million. A large number of plant and animal species are yet to be identified. There are many more species to be present in the tropics.

The two important measures of species diversity are :

1. **Species richness** : It refers to the number of species per unit area.
2. **Species evenness** : It refers to the relative abundance with which each species is represented in an area.
3. The variety and number of individuals determine the level of diversity of an ecosystem.
4. The Western Ghats have a greater diversity of amphibian species than Eastern Ghats.

137. What is the basis of speciation?

Ans : **FOREIGN 2005**

The amount of genetic variation is the basis of speciation (evolution of new species). It has a key role in the maintenance of diversity at species and community levels. The total genetic diversity of a community will be greater if there are many species, as compared to a situation where there are only a few species. Genetic diversity within a species often increases with environmental variability.

138. Describe ecological role of biodiversity.

Ans : **DELHI 2009**

Ecological role of biodiversity.

1. Biodiversity provides plant pollinators, predators, decomposers and contributed to soil fertility.
2. It helps in the purification of air and water, management of flood, drought and other environmental disasters.
3. Ecosystems with more diversity can withstand the environmental challenges better because genetically diverse species present in the ecosystem will have different tolerance ranges for a given environmental stress, hence they cannot be easily eliminated by any single stress at a time. However, if the ecosystem

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Their boundaries are not well-defined and controlled biotic interference such as tourist activities are permitted. India has more than 500 sanctuaries. e.g. Kewala Dev (Bharatpur, Rajasthan) etc.

2. **Ex situ conservation :** It implies protection of endangered species away from their natural habitat under partially or wholly controlled conditions. It is also called as off site preservation. They include-

(i) **Zoos :** Zoo is the place where wild animals are kept for public viewing. They contain various are species of animals. They have got recorded success in captive breeding of animals.

(ii) **Botanical Gardens :** These are the places where endangered species of plants are grown in protected environment. There are several instances found where, plants believed to be extinct where found living only in a botanical garden. e.g. sophora toromiro.
These are the places where endagered

(iii) **Cryopreservation :** It is a method of preservation where living material are kept at 196°C (liquid nitrogen). It can maintain tissue culture, embryoes, animal cells/tissues, spermatozoa in definitely.
The cryopreserved material is revive through special technique when required.

160. What are sacred groves? Where are they found?

Ans : **COMP 2005**

Sacred groves can be defined as undisturbed patches of vegetation on the outskirts of villages and towns or in the plains or a part of forested areas that are dedicated to local folk deities or ancestral spirits. They are fine examples of in-situ conservation. They vary in size between 05-500 hectares. Their existence depends upon the social traditions and taboos incorporating spiritual and ecological values which prevent their destruction. These groves represent an invaluable gene pool, conserve the biodiversity and are found all over the country under different names. Sacred groves provide various ecosystem services such as biodiversity, medicinal plants; regulating services and the range of functions carried out by ecosystems. It also serves as a repository for biodiversity. These pristine patches of forests have been instrumental in saving many vanishing species that might otherwise have been destroyed. The entire ecosystem helps in soil and water conservation, apart from preserving biological wealth. They are a dependable source of water for organisms living in and around the sacred groves. Hunting, logging and other developmental activities are strictly prohibited within the sacred groves. Besides, the sacred groves serve to maintain the precious age old religious and cultural practices, beliefs and customs that might otherwise have been lost in this era of globalization and mass culture.

161. What is biosphere reserve? Show the zonation of biosphere reserve.

Ans : **OD 2013**

Biosphere Reserves : Biosphere reserves are a special category of protected areas of land and/or coastal environments, wherein people are an integral component of the system. These are representative examples of natural biomes and contain unique biological communities.

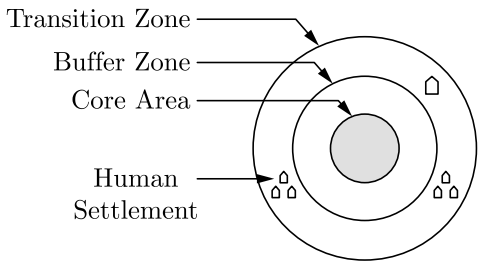

Fig The zonation in a terrestrial Biosphere Reserve

Recently, the concept of Biosphere Reserves has been evolved by UNESCO's Man and Biosphere Programme (MABP). Till May 2002, there are 408 biosphere reserves located in 94 countries out of which 13 are in India. Of these, the Nilgiri Biosphere Reserves was declared in 1986.

Zones of Biosphere Reserve : A biosphere reserve is divided into three zones : core, buffer and manipulation.

1. **Core Zone** : No human activity is allowed in the core zone.
2. **Buffer Zone** : Limited human activity is permitted in the buffer zone.
3. **Manipulation Zone** : Several human activities can occur in the manipulation zone.
4. **Mass extinction** : Complete removal of species or wiping out of entire families from the face of the earth is called mass extinction. Mass extinction is generally due to changing climate conditions.

   An example of mass extinction is the complete disappearance of dinosaurs at the end of cretaceous period.
5. **India's effort in biodiversity conservation** : India has greatly contributed to conservation of biodiversity owing to its great utility and

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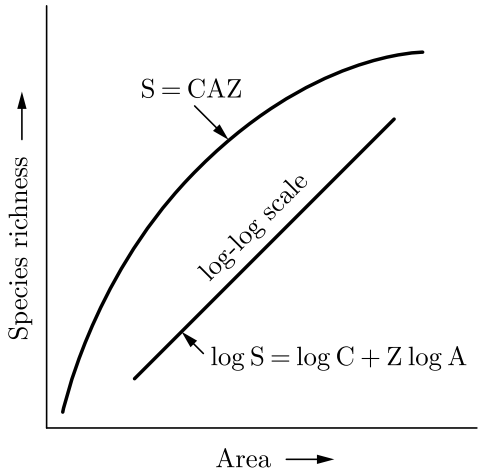

Fig Species area relationship

Ecologists have found out that the value of Z-line ranges between 0.1 and 0.2 irrespective of the taxonomic group or the region.
But this analysis in very large areas like a continent, the Z value ranges between 0.6 and 1.2. The Z value for frugivorous birds and mammals in the tropical forests is found to be 1.15.

143. Explain biodiversity as sources of food and improved varieties.

Ans : **OD 2020**

Use of biodiversity in agriculture :

1. As a source of new crops.
2. As a source material for breeding varieties.
3. As a source of new biodegradable pesticides.

Only 20% of total plant species are cultivated to produce 85% of world's food.
Wheat, corn and rice, the three major carbohydrate crops, yield nearly two-thirds of the food sustaining the human population. Fats, oils, fibres, etc. are other uses for which more and more new species need to be investigated.

144. List a few drugs and medicines obtained from biodiversity.

Ans : **OD 2010**

Drugs and medicines from biodiversity : Several important pharmaceuticals have originated as plant-based substances. Examples of plant-derived substances developed into valuable drugs are : Morphine (Papaver somniferum), used as an analgesic; Quinine (Chinchona ledgeriana) used for the treatment of malaria; and Taxol, an anticancer drug obtained from the bark of the yew tree (Taxus brevifolis, T. Baccata). Currently, 25% of the drugs in the pharmacy are derived from a mere 120 species of plants. But, throughout the world, traditional medicine make use of thousands of plant species. Plants can also be used for the manufacture of innumerable synthetic products, called botanochemicals.

145. Briefly explain role of biodiversity in Industry.

Ans : **DELHI 2017**

Role of biodiversity in Industry :

1. Wild plants, animals and their products are of great importance to industry as sources of tannins, resins, gums, oils, dyes, fragrance, perfumes, waxes, lubricants, hydrocarbons, rubber, latex and other commercially useful compounds.
2. Some products of animal origin include wool, silk, fur, leather, waxes and lubricants.
3. With the development of modern technologies the potential for new industrial products from currently unknown or poorly known plant and animal species is immense.

146. Give a brief account of loss of biodiversity at global level.

Ans : **SQP 2007**

The colonisation of tropical Pacific Islands by human beings has led to the extinction of more than two thousands species of native birds.
IUCN red list (2004) documents the extinction of 784 species in the last 500 years that include 359 invertebrates, 338 vertebrates and 87 plants.
Some of the animals that have become extinct in recent times are given below:

1. Steller's sea cow (Russia)
2. Dodo (Mauritius)
3. Thylacien (Australia)
4. Quagga (Africa)
5. Three sub-species (Bali, Javan, Caspian) of tiger.
6. 27 species have become extinct in the last twenty years alone.
7. Amphibians are more vulnerable to extinction.

Though about 15,5000 species are facing extinction, at present the following face the threat of extinction :

1. 31% of gymnosperms
2. 32% of amphibians
3. 12% of bird species
4. 23% of mammals

Since the origin of life on earth and evolution, three have been five episodes of mass extinction, but the current rate of extinction is 100-1000 times faster than them, due to human activities.

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contains only few species, it will become a fragile or unstable ecosystem.

4. The species with high genetic diversity and the ecosystems with high biodiversity have greater capacity for adaption against environmental perturbations.

139. Write a short note on three perspectives of community and ecosystem level of diversity.

Ans : **OD 2013**

The three perspectives of diversity at level of community and ecosystem are:

1. **Alpha diversity** : It refers to diversity of organisms sharing the same community. It has been found that there is increase in diversity with decrease in latitude.
2. **Beta diversity** : The rate of replacement of species along a gradient of habitat or communities is called beta diversity.
3. **Gamma diversity** : It is rate at which additional species are found as replacement in different localities of the same habitat.

140. Discuss the characteristics of India's biodiversity.

Ans : **OD 2009**

Biodiversity is not uniformly distributed in space and time. It is rich in tropics. India's biodiversity is characterised by the following:

1. India contains 10 biogeographic regions which include the Himalayan, Trans-Himalayan, the Indian desert, the Semi-arid zone, the Western-Ghats, the Deccan Peninsula, the Gangetic Plain, North-East India the Islands and Coasts which possess different biodiversity levels.
2. India is one of the world's 12 leading biodiversity centres of the origin of cultivated plants.
3. Though India has only 2.4% of the land area of the world, it has 8.1% of the global species biodiversity.
4. There are about 45000 species of plants and 90,000-1,00,000 species of animals; many more species are yet to be discovered and named.
5. If we apply **Robert May's** global estimate that only 22% of the total species have been recorded, India probably has more than 1,00,000 species of plants and 3,00,000 species of animals to be discovered and described.
6. India has 5 natural world heritage sites, 14 biosphere reserves, 89 national parks, 492 wildlife sanctuaries and 2 hot spots. Heritage sites are the places that attract tourists.
7. About 33 percent of the country's recorded flora are endemic to India and concentrated in the North-East, Western-Ghats, North-West Himalayas and Andaman and Nicobar islands.

141. Give an account of global biodiversity.

Ans : **SQP 2020**

Global Biodiversity :

1. According to IUCN (2004), the total number of plant and animal species described is about 1.5 million. The species invertories for taxonomic groups in temperate countries/ regions is more complete than that in tropical countries/regions.
2. A more conservative and scientifically sound estimate has been made by Robert May; it puts the global species diversity at about seven million. More than 70% of all the species recorded are animals and plants account for about 22%; 70% of the animals are insects.

These estimates do not give any figure for prokaryotes for the following reasons :

1. The conventional taxonomic methods are not suitable/sufficient for identifying these microbial species.
2. Many of these species cannot be cultured under laboratory conditions.
3. Biochemical and molecular biology techniques would put their diversity into millions.

142. Describe species area relationship.

Ans : **COMP 2020**

Alexander Von Humboldt has observed that within a region, species richness increased with increased explored area, but only upto a limit.

The relationship between species richness and area for a number of taxa like angiospermic plants, freshwater fishes and birds is found to be a rectangular hyperbola.

On a log scale, the relationship becomes linear (straight line) and is described by the equation.

$$\log S = \log C + Z \log A.$$

where, S = Species Richness

Z = Slope of the line (regression coefficient)

A = area and C = y − intercept

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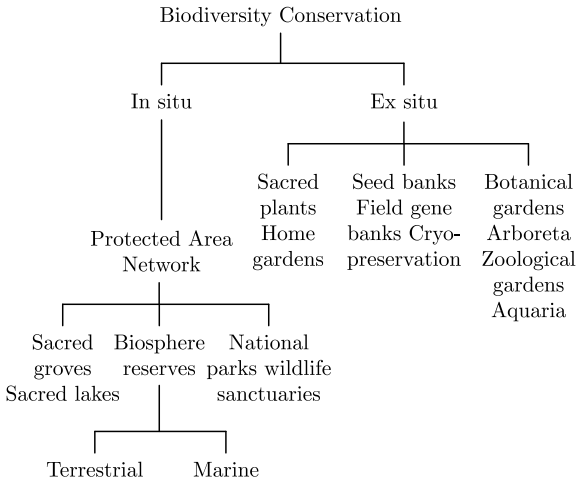
3. **Development** : They ensure culturally, socially and ecologically sustainable economic development.
4. **Monitoring** : There is a regular monitoring of development and conservation progress.
5. **Education and research** : Each biosphere reserve supports education of information about research, restoration, conservation and development aspects at the national and global levels.

152. Show the in situ and ex situ approaches of conserving biodiversity in India.

Ans : **COMP 2017**



153. Give an account of latitudinal gradients of biodiversity.

Ans : **DELHI 2015**

Latitudinal gradients of biodiversity :

1. Species diversity decreases from equator towards poles.
2. The tropics (between 23.5°N to 23.5°S) harbour more species than temperate and polar regions.
3. For example, Columbia situated near equator, has about 1400 species of birds, while New York (41°N) has 105 species, Greenland (70°N) has about 56 species and India (in the equator region) has 1200 species.
4. The number of species of vascular plants in tropics is about ten times more than that of temperate forests.
5. The Amazonian rain forest in South America has the greatest biodiversity on earth; it harbours about 40000 species of plants, 1,25,000 species of insects, 3000 of fishes, 427 of amphibians, 378 of reptiles, 1300 of birds and 427 of mammals.

154. Explain effects of habitat fragmentation on biodiversity.

Ans : **FOREIGN 2008**

Effect of habitat fragmentation on Biodiversity:

1. Fragmentation creates barriers that limit the potential of species to disperse and colonise new areas.
2. Species get divided into smaller populations which are unable to sustain.
3. Migratory birds lose their seasonal habitats.
4. It increases edge areas thus making the species more vulnerable to predators as well as wind and fire.

Thus there is loss of biodiversity because a large number of animals, e.g. elephants, lions, bears, and large cats require big territories to move around and live in. Likewise some birds reproduce successfully only in deep forests.

155. How is introduction of exotic species leading to endangering the species ?

Ans : **SQP 2019**

Exotic species are having large impact especially in island ecosystem, which harbour much of the world's threatened biodiversity. A few examples are:

1. Nile perch, and exotic predatory fish introduced into Lake Victoria (South Africa) threatens the entire ecosystem of the lake by eliminating several native species of the small Cichlid fish species that were endemic to this freshwater aquatic system.
2. Water hyacinth clogs rivers and lakes and threatens the survival of many aquatic species in lakes and river flood plains in several tropical countries including India.
3. Lantana camara has invaded many forest lands in different parts of India, and strongly competes with the native species.

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156. List and explain the three types of extinction processes.

Ans : **SQP 2020**

Types of extinction processes are as follows :

1. **Natural extinction** : With the change in environmental conditions, some species disappear and others, which are more adapted to changed conditions, take their place. This loss of species which occurred in the geological past at a very slow rate is called natural or background extinction.

147. Broadly classify the extinction processes.

Ans : **OD 2016**

Classification of extinction processes :

1. **Natural extinction** : It is due to change in environmental condition. It is a very slow rate.
2. **Mass extinction** : Mass extinction occurs due to catastrophes. In this case large number of species became extinct in millions of years.
3. **Anthropogenic extinction** : Extinction of species due to man's activities. It is occurring in a short period of time.

148. Explain the following :

1. IUCN Red list
2. Protected areas.

Ans : **SQP 2020**

1. **IUCN Red List** : It is a catalogue of taxa that are facing the risk of extinction. The uses of red list are (a) developing awareness, about the threat of loss of biodiversity (b) identification and documentation of endangered species (c) providing a global index of the decline of biodiversity (d) defining conservation.

   IUCN has recognized eight red list categories of species. They are :

   (a) Extinct, (b) Extinct in wild, (c) Critically endangered, (d) Endangered, (e) Vulnerable, (f) Lower risk, (g) Data deficient and (h) Not evaluated.

   The 2000 red list contains assessment of more than 18,000 species, 11,000 of which are threatened.
2. **Protected areas** : These areas are land or sea are dedicated to protection and maintenance of biological diversity. They include National Parks, Sanctuaries and Biosphere reserve.

   As on Sept. 2002, India has 581 protected areas.

   National Parks : A National Park is an area which is strictly reserved for the betterment of the wildlife and where activities like forestry, grazing or cultivation are not permitted. In these parks, even private ownership rights are not allowed.

   Sanctuaries : A sanctuary is a protected area which is reserved for the conservation of only animals and human activities like harvesting of timber, collection of minor forest products and private ownership is allowed so long as they do not interfere with well being of animals.

   A biosphere reserve is a specified area in which multiple use of the land is permitted by dividing in into certain zones, each zone being specified for a particular activity.

149. What is the purpose of preparation of red list ? List the categories of red list.

Ans : **DELHI 2019**

The purpose of preparation of red list is to :

1. Provide awareness to the degree of threat to biodiversity.
2. Provide global index about already decline of biodiversity.
3. Identification and documentation of species at high-risk of extinction.
4. Preparing conservation priorities and help in conservation action.
5. Information about international agreements like Conservation on Biological Diversity and CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora).

Categories of red list :

Red list has eight categories of species.

These are extinct, extinct in wild, critically endangered, endangered, vulnerable, lower risk, data deficient and not evaluated species.

150. List the benefits of protected area or conservation of biodiversity.

Ans : **OD 2007**

Benefits of protected areas :

1. Maintaining viable populations of all native species and subspecies.
2. Maintaining the number and distribution of communities and habitats, and conserving the genetic diversity of all the present species.
3. Preventing human-caused introduction of alien species.
4. Making it possible for species/habitats to shift in response to changes in the environment.

151. Write importance of biosphere reserves.

Ans : **SQP 2009**

The importance of biosphere reserve includes :

1. **Restoration** : Biosphere reserves help in restoration of degraded ecosystems and habitats.
2. **Conservation** : They are means of conserving genetic resources, species, ecosystems and landscapes without uprooting the local people.

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4. **Economic value :** Wild species of animals not only provide meat but their skin is used as fur. Many animal products like horns and ivory, a good source of income for the country.
5. **Genetic Value :** Biological diversity has a great value as a gene bank of nature. It is of extreme importance in breeding programmes in agriculture, animal husbandry etc.
6. **Medicinal value:** There are so many varieties in the wild whose medicinal importance can help to save lives of many people. They can be used to treat cancer, AIDS etc.

Loss of Biodiversity- The main reasons for depletion of biodiversity are as follows:

1. **Habitat destruction :** With industrialization, man is trying to acquire more land to build dams, reservoirs, crop lands, industries, human dwelling etc. This takes away the cover or shelter of forest vegetation, tall grasses and natural habitat of wild animals and leads to the extinction of species.
2. **Environmental pollution-** Today our environment faces an array of environmental problems related to pollution of air, water and land, Pollution destroys the ecosystems and in the process the wealth of species that inhabit our planet.
3. **Deforestation and land degradation :** By conversion of tropical forests into agricultural lands and high level of timber production we are not only disturbing the ecosystem but losing a large number of wild species of organisms. We may grow the plants again but a species lost can not be retrieved.
4. **Hunting as a sports or for money :** Needless killing of wild animals for the sake of enjoyment recreation and for a handsome amount of money has already led to extinction of many species and is putting many on the endangered list.
5. **Deliberate introduction of new, exotic species in natural environment :** The new species pose competition for food, space and predation for the existing species. It may also lead to transmission of diseases and parasites not present before.
6. **Over exploitation :** Over exploitation of forests, mining, fresh water and marine living resources ultimately affects the population of wild life. Extinction of many species of fish, molluscs, whales, sea cows, sea turtles is due to excessive use of sea food.

159. What do you understand by conservation? Describe the methods how biological resources are conserved.

Ans : **FOREIGN 2012**

Conservation of biological resources means providing protection, upliftment and scientific management of biological resources in order to maintain it, at its optimum level in order to derive the sustainable benefits for present and future generations as well.

There are two major strategies used to conserve biodiversity.

1. **In situ Conservation :** It involves conservation and protection of the whole ecosystem and its concerned biodiversity at all levels in order to provide protection to both threatened as well as endangered species. In it, endangered species is protected and conserved in their own natural environment so that they flourish and evolve in their nature surroundings.

(i) **Hotspots :** Biodiversity hotspots are biogeographic region that are extremely which in species diversity. They are characterised both by exceptional levels of plants endemism and by serious level of habitat loss. Among the 34 hotspots of the words, two are found in India extending into neighbouring countries. These two are the westerns Ghats/Sri Lanka and the Indo-Burma Region (covering the Eastern Himalayas)

(ii) **Biosphere reserves :** They are multipurpose protected areas which are meant for preserving genetic diversity in representative ecosystems of various natural biomes and unique biological communities by providing protection to the wild populations, traditional lifestyle of tribals and domesticated genetic resources. The biosphere reserves are actually the subjects of scientific and natural interest. e.g. Nanda Devi (uttarakhand), Manas (Assam) etc.

(iii) **National parks :** These are large areas of scenic and natural beauty strictly maintained by government for scientific, educational and recreational use. They are reserved for the betterment of the wildlife where the activities like cultivation, grazing, forestry and habitat manipulation are not permitted. e.g. Kanha National Park (M.P), Dulhwa National Park (U.P.) etc.

(iv) **Sanctuaries :** These are piece of land meant for protection of fauna. Here, Controlled harvesting activities such as forestry, tilling of land and grazing are permitted as long as they do not interfere with well-being of animals.

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2. **Mass extinction** : There have been several periods in the earth's geological history when large number of species became extinct because of catastrophes. Mass extinctions occurred in millions of years.
3. **Anthropogenic extinction** : An increasing number of species is disappearing from the face of the earth due to human activities. This man-made mass extinction represents a very severe depletion of biodiversity, particularly because it is occurring within a short period of time.

157. Define the IUCN Red list categories.

Ans : **COMP 2010**

Red list category	Definition
Extinct	A taxon is Extinct when there is no reasonable doubt that the last individual has died.
Extinct in the wild	A taxon is Extinct in the wild when exhaustive surveys in known and/ or expected havitats, have failed to record an individual.
Critically endangered	A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future.
Endangered	A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future.
Vunerable	A taxon is Vulnerable when it is not Critically Endangered or Endangered, but is facing a high risk of extinction in the wild in the medium term future.
Lower risk	A taxon is Lower Risk when it has been evaluated and does not satisfy the criteria for Critically Endangered, Endangered or Vulnerable.
Data deficient	A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of.
Not evaluated	A taxon is Not Evaluated when it has not yet been assessed.

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LONG ANSWER QUESTIONS

158. What do you mean by Biodiversity? What is the importance of species Biodiversity in Ecosystem. Describe main reasons for depletion of Biodiversity.

Ans : **SQP 2011**

The term biodiversity was coined by Watter G Rosen in 1986. It refers to the occurrence of different types of genes, gene pools, species habitats and ecosystems in a particular place in various parts of earth. It is variety and variability among living organisms and the ecological complexes in which they occur.

Species diversity includes the complete range of species on earth, (from micro-organisms such as bacteria, virus, protozoans through multicellular organisms like plants, fungi and animals) It represents the variety of species within a region.

Importance of Biodiversity

1. **Ecological Balance :** Each species in the ecosystem plays an important role in balancing the population, maintaining the food chain and natural cycles on the earth. They help to make environment a self sustaining system.
2. **Survival value :** The rich diversity of today is a result of natural evolution that has taken 3.5 billion years on earth.
3. **Scientific value :** Wild life provides valuable information to naturalists and biologists in understanding the environment, ecology and behaviour. These animals are also used to study the effects of pollution. Various experiments of medical products are also done one these animals to study their impact on living organisms.

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need for conservation. The following measures have been taken for this purpose :

(a) Setting up of bodies like Indian Board for Wildlife, Bombay Natural History Society etc.
(b) Observation of first week of October as national wildlife week.
(c) Introduction of Wildlife Protection Act in 1972.
(d) Setting up of sanctuaries, national parks and biosphere reserves.
(e) Land races, different types of food and medicinal plants are being conserved by tribal people, woman and some non-governmental agencies.
(f) Major ex situ conservation of biodiversity is being managed by **National Bureau of Plant, Animal of Fish Genetic Resources.**
(g) There is an **International Crop Research Institute for Semi-Arid Tropics** (ICRISAT) in Hyderabad for conserving germplasm of groundnut, pigeon pea, chick pea, peral millet and sorghum.

162. Species diversity decreases as we move away from the equator towards the poles. What could be the possible reasons?

Ans : **DELHI 2006**

Gradients of Biodiversity : The biodiversity varies with change in **latitude** or **altitude**. The biodiversity increases from the **poles** to the **equator**. In the **temperate region**, the climate is serve with short growing period for plants. In **tropical rain forest**, the conditions are favourable for growth throughout the year. Speciation occurs during favourable conditions. Mean number of vascular species per 0.1 ha sample area in tropical rain forests varies from 118-236. This is only in the range of 21-48 species in the **temperate zones**. Such correlation between diversity and latitude exists for a wide variety of taxonomic groups, like ants, birds, butterflies and moths.

There is a decrease in species diversity from lower to higher altitudes on a mountain. A 1000m increase in altitude results in a temperature drop of about 6.5°C. Drop in temperature and **greater seasonal variability** at higher altitudes are a major factor to reduce biodiversity. The **latitudinal** and **altitudinal** gradients of species diversity are two **master gradients**. More complex and diverse flora and fauna will be in complex and heterogeneous physical environment.

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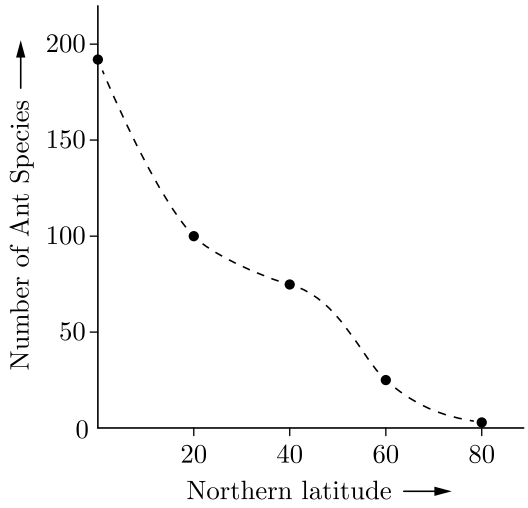

163. Explain briefly the **rivet popper hypotesis** or Paul Ehrich.

Ans : **FOREIGN 2013**

Rivet Popper Hypothesis : It was explained by **Paul Ehrlich**. He compares an aeroplane to an ecosystem and all the parts joined together by rivets (species). He said when each passenger of aeroplane begins **popping a rivet** to carry to his house (it means species will become extinct); it cannot affect **flight safely** (it means properly functioning of an ecosystem) in the beginning but when more rivets (species) will be removed from aeroplane (ecosystem), it will become weak and would cause danger to safety of aeroplane. Moreover, the loss of rivets on wings of aeroplane (the key species) would be a cause of serious concern.

164. The relation between species richness and area for a wide variety of taxa out to be a rectangular hyperbola. Give a brief explanation.

Ans : **OD 2011**

Species-Area Relationships : Great German naturalist and geographer **Alexander von Humboldt** observed South American jungles. He stated within a region species richness increased with increasing explored area, but it happens only up to a certain limit. For example, the relation between **species richness** and **area** for a wide variety of taxa say angiosperms, freshwater fishes, birds and even bats; turns out to be a **rectangular hyperbola**.

On a logarithmic scale, this relationship is a straight line. It is explained by the following equation as :

$$\log S = \log C + Z \log A$$

[where, S = species richness,

A = area

Z = slope of line (regression coefficient)

C = Y-intercept

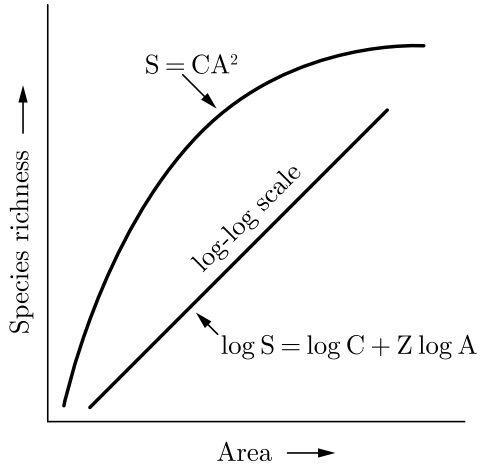

Fig Showing species area relationship. Note that on log scale the relationship become linear.

The ecologists found the value of Z lies in a range of 0.1 to 0.2, regardless of a **taxonomic group** or even a region for e.g. it may be plants in Britain, or the birds in **California** or the molluscs in New York **slopes of regression line** are quite same.
Suppose we analyse **species-area relation-ships** among extremely big regions or the areas such as **entire continents**, we should then find the slope of the line to be much steeper (Z values in range of 0.6 to 1.2). We can give the following example to explain it. For **frugivorous** or the **fruit eating** birds (Aves) and mammals in tropical forests of various continents, slope in 1.15. It explains the significance of the slope of regression in a species-area-relationship.

165. Write critical notes on the following :

1. Hotspots of biodiversity
2. Ex-situ conservation
3. Biosphere reserves
4. Genetic diversity
5. Mass extinction
6. India's effort in biodiversity conservation.

Ans : **SQP 2008**

1. **Hot Spots of Biodiversity** : These are megadiversity zones having large number of species. India has 2.4% land area under this category. **Normal Mayer** (1988) developed this concept. There are 2 hot spots in India. In world there are 25 hot spots.
2. **Ex-situ Conservation** : This approach includes the protection of a group of typical ecosystems through a network of protected area. It includes **botanical gardens, zooz, gene, pollen** and **seed banks** or **germplasm banks** etc. Storage of materials is done by **cryopreservation** method. A frozen zoo has been established by **Zoological Society** of San Diego to store samples of app. 355 species of **mammals, birds** and **reptiles**.
3. **Biosphere Reserves** : These are special categories of protected areas of land or coastal environmental where in people are in integral component of the system. This concept was launched in 1975 under **MAB programme**. There are 13 biosphere reserves in India. Biosphere reserve consists of **core, buffer** and **transition zones**.
4. **Genetic Diversity** : It refers to the variations of genes within species and the variations may be in the alleles of a gene or in the entire gene or in chromosome structure. The number of genes in humans is about 31,000 but in E.coli. the number of genes is app. 3200.
5. **Mass Extinction** : The extinction of a relatively large number of species within a shorter span of time due to the catastrophes in the earth's geological history is known as the **mass extinction**. It occurs in million of years in earths history.
6. **India's Effort on Biodiversity Conservation** : India's Parliament passed **Biodiversity Bill** in Dec. 2003 to protect India's biodiversity. It aims to check **biopiracy** and the use of our biodiversity by the foreign nations. the **Biodiversity office** is is **Chennai**. The people of a village (Puttavam) in Kerala took initiative to ownership of biodiversity and established a **forum for protection of people's Biodiversity**.

166. Broadly classify the extinction processes.

Ans : **SQP 2020**

The extinction of species is a natural process. Species have disappeared and new ones have evolved to take their place over. There are **three** types of extinction processes.

1. **Natural Extinction** : When there is change in environment conditions, certain species **disappear** and other, (which are more adapted to changed conditions) take their place. This loss of species that occurred in the geological past at a very slow rate is known as **natural (background extinction)**.

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2. **Mass extinction** : There have been several periods in the earth's geological history when large number of species became extinct due to **catastrophes**. It occurred in millions of years.
3. **Anthropogenic Extinction** : More number of species is disappearing from the face of the earth due to human activities. Man-made mass extinction represents a very severe depletion of biodiversity.

   World Conservation Monitoring Centre has recorded that 533 animal (mostly vertebrates) and 384 plant species (mostly flowering plants) have become extinct since the year 1600.

   The **current rate of extinction** is 1000 to 10000 times higher than the background rate of extinction.

167. Write short notes on :

1. Ramsar Convention
2. Ramsar Mission.

Ans : **COMP 2010**

1. **Ramsar Convention** : It is a convention on the wetlands of **international importance** for national action as well as international for preservation of wetlands. This also for wise use of wetlands alongwith their resources. This also for wise use of wetlands alongwith their resources. This being a global environmental treaty deals with specific ecosystem. It was adopted in **Ramsar city of Iran** in the year 1971. In all geographical zones/regions of the planet, thore so many **convention Member Countries.**
2. **Ramsar Mission** : Conservation & wise use of all wetlands by local, national as well as international cooperation, as a contribution to achieve the sustain able development in the whole world is the **mission** of Ramsar convention.

It Uses :

(a) Broad definition of all wetlands, and their types;
(b) Lakes, rivers, marshes, swamps, wet grasslands, oasis, wetlands, deltas, estuaries, tidal zones, coral reefs, fish ponds, salt pans, reservoirs and near coast areas etc. are included in it.
(c) So, it is our duty to conserve wetlands after identifying them in interest of people of world.

168. How is the sixth episode of extinction of species on earth, now currently in progress, different from the five earlier episodes? What is it due to? Explain the various causes that have brought about this difference.

Or

Since the origin of life on Earth, there were five episodes of mass extinction of species.

1. How is the Sixth Extinction presently in progress, different from the previous episodes?
2. Who is mainly responsible for the Sixth Extinction?
3. List any four points that can help to overcome this disaster.

Ans : **COMP 2011**

1. **Sixth Episode of Extinction of Species** in now in progress. It is occurring at a faster rate than the previous 5 episodes of mass extinction of specis. The main reason is human activities like pollution, destruction of habitats of species and poaching etc. **The current species extinction rate is approximately 100 to 1000 times faster than in pre-human times.**
2. We are responsible for it today. In near future half of the species in the entire world would be extinct in about a hundred years time only. The 5 episodes of extinction occurred app. $>$ 3 billion years ago and there was mass extinction (large scale loss of species) before humans appeared. It is evident from the **geological and fossil records** of ancient times. The amphibians are more **vulnerable** to the process of entinction.
3. All this is now, due to human activities. Such as **co-extinctions, habitat loss, introduction of alien species and over explitation** as well as **fragmentation**.

169. Explain the protected areas in our country.

Protected Areas in India : India is very rich with various biogeographical provinces. There ranges from the **cold deserts of Ladakh** and **Spiti** to the hot deserts of the Thar; the temperature forests in the Himalaya to the lush green tropical rain forests of the low lands. India had abundance of large fresh water bodies such as the Woolar and the **Manasbal lakes** in **kashmir**, the **Chilka** in Orissa and the **Kolleru** lake in Andhra Pradesh and the rugged and rich coastline and coral reefs of the Deccan.

To protect, preserve and propagate this varied nature's gift the **Government of India** passed the **Wildlife (Protection) Act in 1972**, under which National Park and sanctuaries could be created.

1. **National Park** : A National Park is an area

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(i) What will happen to species area relationship among very large areas like continents.

(ii) List any two characteristics of a stable community.

(iii) Who proposed Rivet popper thypothesis ?

Ans : **OD 2006**

(i) The slope will be much steeper.

(ii) (a) does not show too much variations in year to year productivity.

(b) Must be resistant to occasional distur – bances.

(iii) Paulk Ehrlich.

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distribution. Mention what this kind of diversity is referred to as.

(iv) Why is it that prokaryotes do not have an estimated number of their species diversity as seen in plants and animals ? Explain.

Ans : **OD 2024**

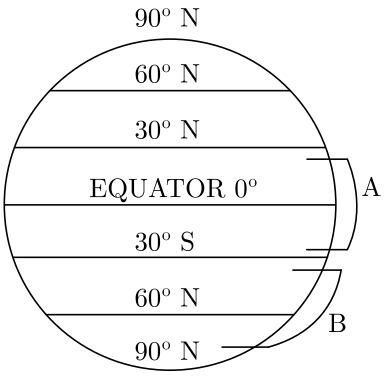
(i) This region is less seasonal with constant and more predictable environment / More solar energy so higher productivity and higher diversity / it represent tropical lattitudes which remain relatively undisturbed for millions of years and had a long evolutionary time for species diversification.

(ii) Region I represent temperate region subjected to frequent glaciation and get lesser evolutionary time for species diversification/ has more seasonal with less constant and less predictable environment which lead to lower specie diversification / have lower solar energy available which reduces productivity and inturn contributes to lesser diversity.

(iii) Latitudinal gradient in diversity

(iv) Conventional taxonomic methods are not suitable for identifying microbial species, and many species are not culturable under laboratory conditions.

172. Study the diagrammatic representation given below of the Earth with regions marked 'A' and 'B' respectively. Answer the questions that follow.



(i) Write the observations made regarding the species diversity when moving from region 'A' to region 'B' Given two reasons also.

(ii) Stating the reason, mention the approximate number of bird species recorded in India.

(iii) Name the region in the world that records the greatest biodiversity and mention why.

Ans : **OD 2023**

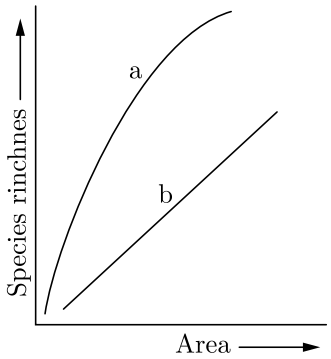
(i) Species diversity decreases as we move from region A to region B.

Reasons : less Constant mean annual temperature, lesser habitable land area, availability of lesser solar energy, lesser productivity, any other correct reason in 'B' region. (Any two)

(ii) More the 1200 species of birds, Indian land mass being largely in the tropical latitudes.

(iii) Amazonian rainforest (in South America), mainly being in tropical region.

173. The graph shows species area relationship. If b denotes the relationship on log scale :



(i) Describe a and b.

(ii) How is slope represented ? Give the normal range of slope.

(iii) What kind of slope will be observed for frugivorous birds nad mammals in a tropical forest ?

Ans : **FOREIGN 2006**

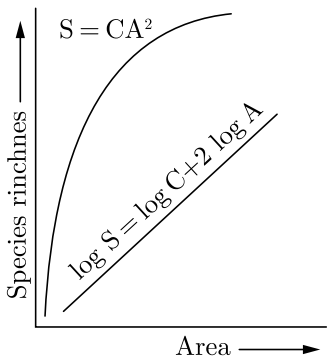
(i) a is $S = CA_2$

$$\text{B is log S} = \log \text{C} + \text{Z} \log \text{A}$$

(ii) Slope is Z (regression coefficent. Its normal ranges from 0.6 to 1.2.

(iii) In frugivorous birds and mammals, value of Z = 1.15.

174. Alexander Von Humboldt, a German naturalist during his pioneering and exploration in the wilderness of south American Jungles observed that with in a region, speciecs richness and area turns out to be a rectangular hyperbola.



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which is strictly reserved for the betterment of the wild life and where activities such as forestry, grazing or cultivation are not permitted and no private ownership right is allowed. There are **96 National Parks** in the country spread over an area of 33,988; 14 square kilometres or nearly 1 percent of the country's geographical area.

2. **Wildlife Sanctuary** : In a Sactuary, protection is given only to the fauna and operations such as harvesting of timber, collection of minor forest products and private ownership rights are permitted so long as they do not interfere with the will-being of animals. There are presently **551 sanctuaries** in India (India 2005) covering over 1,07,310,13 square kilometres, amounting to 3.2 percent of India's total geographical area.

CASE BASED QUESTIONS

170. In this approach, threatened animals and plants are taken out from their natural habitat and placed in special setting where they can be protected and given special care. Zoological parks, botanical gardens and wildlife safari parks serve this purpose. There are many animals that have become extinct in the wild but continue to be maintained in zoological parks. In recent years ex situ conservation has advanced beyond keeping threatened species in enclosures.

Now gametes of threatened species can be preserved in viable and fertile condition for long periods using cryopreservation techniques, eggs can be fertilised in vitro, and plants can be propagated using tissue culture methods. Seeds of different genetic strains of commercially important plants can be kept for long periods in seed banks.

Biodiversity knows no political boundaries and its conservation is therefore a collective responsibility of all nations. The historic Convention on Biological Diversity ('The Earth Summit') held in Rio de Janeiro in 1992, called upon all nations to take appropriate measures for conservation of biodiversity and sustainable utilisation of its benefits.

In a follow-up, the World Summit on Sustainable Development held in 2002 in Johannesburg, South Africa, 190 countries pledged their commitment to achieve by 2010, a significant reduction in the current rate of biodiversity loss at global, regional and local levels.

(i) What was the outcome of the 1992 Earth Summit in Rio de Janeiro?

(ii) For endangered species, Ex-situ conservation is a method that is?

(iii) Which one of the following is related to ex-situ conservation of threatened animals and plants?

(iv) World summit on sustainable development of 2002 was held in?

Ans :

(i) The earth summit held at Rio de Janeiro in 1992 resulted into convention on Biodiversity.

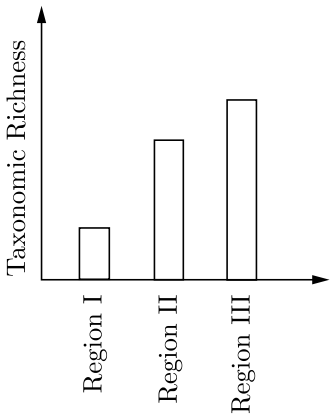
(ii) An ex situ conservation method for endangered species is cryopreservation.

(iii) Wild life safari parks is related to ex-situ conservation of threatened animals and plants.

(iv) World summit on sustainable development of 2002 was held in South Africa.

171. Isn't it incredible that India's land area is only 2.4 per cent of the world's total land area whereas its share of the global species diversity is an impressive 8·1 per cent ! However, in these estimates of species, prokaryotes do not figure anywhere.

Biologists are always keen on collecting data with respect to species diversity observed in different regions of the world. The data collected based on the survey conducted for species richness of groups of mammals in three different regions of the world is shown in the bar graph given below :



(i) Why is the species richness maximum in Region III in the bar graph ?

(ii) Why is the species richness minimum in Region I in the bar graph ?

(iii) Plants and animals do not have uniform diversity in the world but show rather uneven

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